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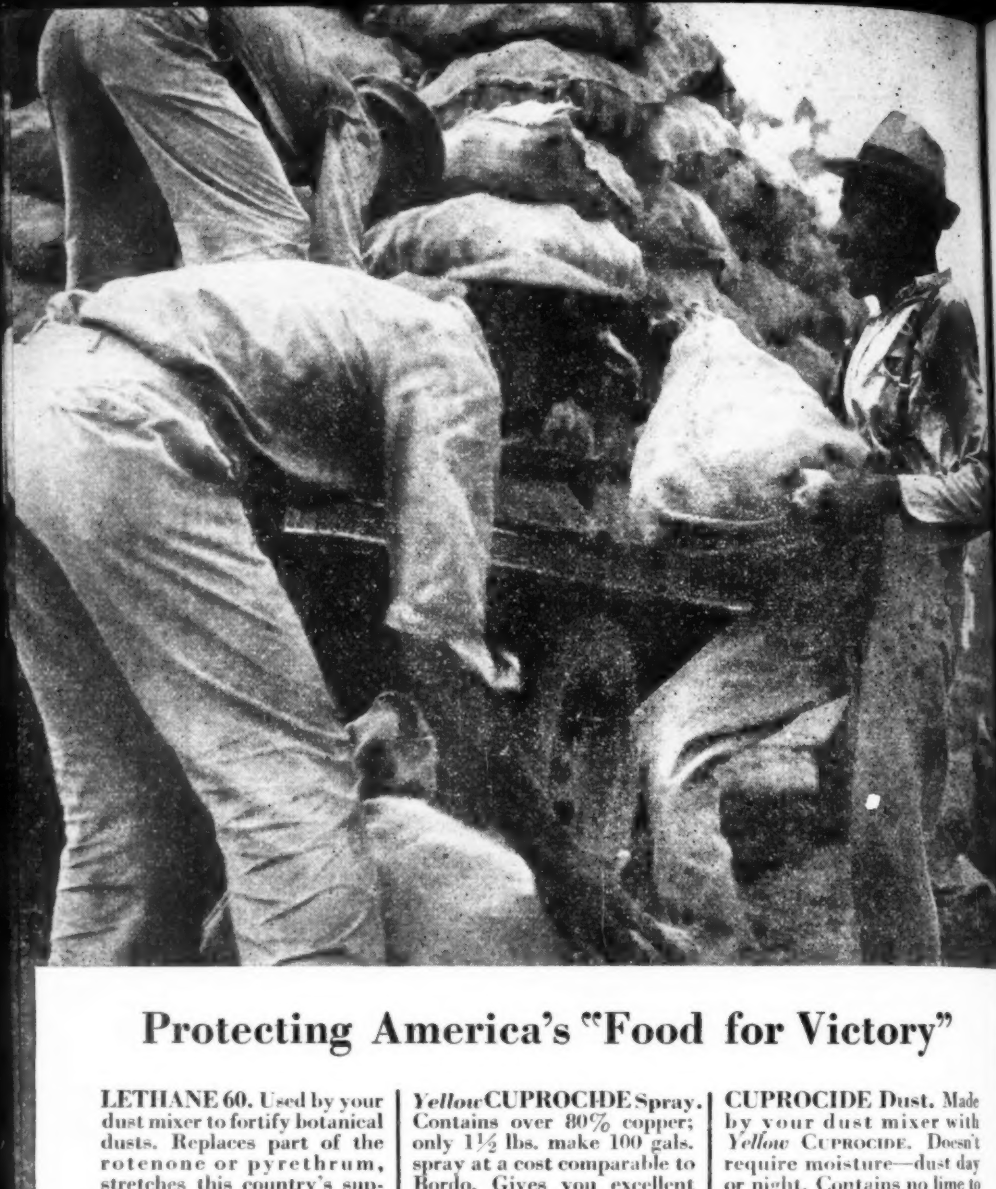

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NEW BRUNSWICK, N. J.

VIRUS LEAF ROLL RESISTANCE IN THE POTATO

F. J. STEVENSON[1]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

AND

DONALD FOLSOM[2]

Maine Agricultural Experiment Station, Orono, Me.

AND

T. P. DYKSTRA[3]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

Virus leaf roll has been a problem in potato growing for a comparatively long time, but only during recent years has it become a serious menace in some of the best potato-growing sections of the United States. Its symptoms have been described by a number of pathologists, and for the most part the descriptions are in close agreement. This agreement might indicate that the symptoms are clear-cut and that diagnosis of the disease is quite simple. This may be true if the observations are made in the early stages of growth of the plant, but in later stages other factors, such as drought, approaching maturity, and injury by other diseases and by insects, may cause leaf rolling that is very easily confused with the condition resulting from infection by the

[1]Senior Geneticist
[2]Head of Department of Plant Pathology.
[3]Pathologist.

leaf roll virus. In typical cases of virus leaf roll the leaves are permanently rolled; that is, they do not roll when the weather is dry and hot and then unroll when conditions become more favorable. On some varieties the leaflets become light greenish-yellow; on others, bronzed reddish or purplish. The leaflets have a tendency to turn upward on the midrib, giving them a tubular spoon-shaped form, and the plant a stiff erect appearance. The lower leaves are rolled and leathery or brittle. In severe cases the affected plants are easy to distinguish from the healthy, since they are often yellowish-green instead of dark green. Often, too, diseased plants are considerably dwarfed.

Reductions in yield result from such injury to the plants, the amount depending to a great extent on the growing conditions under which the crop is produced. Under the most favorable conditions some varieties, such as the Katahdin, may yield a fair crop of smooth well-shaped tubers, even when approximately 100 per cent of the plants are infected with the leaf roll virus; under other conditions or in other varieties the diseased plants yield very little. Reduction in yield is the only serious difficulty when some varieties, including Katahdin, Chippewa, and Sebago, become infected with leaf roll; but other varieties, particularly Green Mountain, often develop net necrosis in the tubers as a result of recent infection with this virus. The outstanding characteristic of net necrosis is the presence of a network of necrotic strands, brown to brownish-black, limited in mild cases to a small portion of the tubers, usually the stem end, but in more severe cases extending throughout the length of the tuber. A very small amount of net necrosis in tubers makes them unfit for seed. Such tubers often produce spindling sprouts resulting in poor stands of weak plants and low yields. Net necrosis also makes the tubers much less valuable as table stock, in many cases making them unfit for human food.

The leaf roll virus is spread by aphids, and in years or places where there are very few or no aphids there is a correspondingly light spread of the disease.

Until recently the control of leaf roll in Maine was not considered difficult. Seed plots could easily be held below the 2-per cent tolerance required for certification by isolation, roguing, and early harvesting. In 1937, however, a heavier infestation of the aphid vector occurred than had ever before been recorded. A correspondingly heavy epidemic of leaf roll resulted, and the next year excessive amounts of the disease were found even in the crops grown from certified seed. From that and subsequent experiences of a similar nature it has become increasingly evident that, unless some practical method of aphid control is

devised, the only satisfactory solution to the problem is to breed resistant varieties. If such varieties were as good as present commercial varieties they would be more desirable than the latter because of lessened need for aphid control.

Literature Citations

European workers have been attacking the problem by breeding methods, as will be seen by a number of literature citations.

At Dahlem, Germany, where potatoes are particularly subject to degeneration, Müller (*3*) showed that varieties differ from year to year in the degree to which the yields are reduced and also in their ultimate yields. No. 9089 which is a selection from a cross of an Amerindian variety from Chiloé with Dolkowski's variety Switez, the hybrid having been backcrossed with one of Broili's land races, was highly tolerant to leaf roll. Selfing 9089 and the variety Erdgold showed that both were heterozygous for resistance. The selfed progeny of 9089 was much less attacked with leaf roll than that of Erdgold, whereas the hybrids between the two were intermediate. The progenies of reciprocal crosses were identical. It was considered that varieties with true resistance to leaf roll, as contrasted with the tolerance of 9089, would ultimately be found.

Köhler (*1*), as a result of field tests at Dahlem in 1937, classified 26 potato varieties into four groups,—the first, susceptible to both leaf roll and Y-virus; the second, susceptible to leaf roll but with reaction to Y-virus not clear; the third, with uncertain reaction to leaf roll but susceptible to Y-virus; and the fourth with reduced susceptibility (either active resistance or tolerance) to both viruses. Altgold, Jubel, Flava, Voran, and Parnassia possessed a high degree of tolerance to leaf roll. In another paper Köhler (*2*) suggested a relationship between resistance to the Y-virus and resistance to leaf roll.

Roth (*4*) reported that Frühgold was resistant to leaf roll. However, it became infected with the disease at Presque Isle, Maine. A report (*5*) from the Scottish Plant Breeding Station at Craigs House, Corstorphine, recorded a very high degree of resistance to leaf roll in two varieties and in their first generation seedlings.

Materials and Methods

A number of European varieties previously reported to show resistance to leaf roll have been brought to this country to be used as parents. Among these are Ackersegen, Albion, Friso, West Brabander, Triumf, Bevelander, Noordeling, Imperia, Kepplestone Kidney, and

Shamrock. Fifty-four varieties brought in by the Erlanson and MacMillan South American Expedition in 1932 and 60 selections from the W races, true seed of which was obtained from K. O. Müller, Berlin-Dahlem, Germany, were included in the tests. A number of American-named varieties, such as Russet Rural, Katahdin, Earlaine, and a number of seedling varieties have been used as parents of crosses and selfed lines, and the progenies tested. Green Mountain and Chippewa, two very susceptible varieties, have been used as checks.

Resistance to leaf roll in the sense in which it is used in this paper is the ability of a variety or seedling to escape infection for a longer period of time than the Green Mountain or Chippewa.

Two methods of testing have been used: the tuber-graft method and the field-exposure test. The tuber-graft method consists in inserting plugs of diseased tubers into the seed pieces of the variety to be tested and planting immediately. The disease reaction can be read when the plants are from 10 to 12 inches in height. In the field-exposure tests a row of seedlings is grown adjacent to a row of diseased plants. In the latter tests the disease reaction cannot be ascertained until the following year. Field-exposure tests have been carried on at Aroostook Farm, Presque Isle, Maine; at Highmoor Farm, Monmouth, Maine; and at the U. S. Bureau of Plant Industry Station, Beltsville, Md.

The varieties and seedlings in the field-exposure tests were replanted until they showed leaf roll, so the data represent the accumulation of the disease for any given period. In the Beltsville tests healthy Green Mountain checks were grown each year so that the spread for a single year on a susceptible variety could be determined.

Results

Thousands of seedlings representing a number of breeding lines were tested at Aroostook Farm and Beltsville by the tuber-graft method, but when none of them showed resistance it was thought advisable to test by the field-exposure method first and if varieties could be found that were not susceptible to leaf roll after from 5 to 10 years' exposure they could be given the more severe tuber-graft test. The field tests at Aroostook Farm in the early years were quite unsatisfactory because of the scarcity of insect vectors and a consequent limited spread of the disease. The Green Mountain checks often escaped infection. At Beltsville a relatively large number of seedlings and varieties have been exposed in the field.

Some of the varieties that were reported to be resistant in Europe,

as well as two American varieties, seemed to be less readily infected than the Green Mountain or Chippewa. In 1942, after 5 years' exposure, Triumf was free from the disease, Bevelander and Shamrock each showed 32 per cent leaf roll, Friso 57, West Brabander 40, Noordeling 72, and Albion 85 per cent. Among the American varieties Green Mountain showed 88 to 100 per cent infection, Chippewa 80, Katahdin 41, and Houma 10. These four varieties were in the test for only 3 years.

It should be noted here that although the Triumf after 5 years' exposure was free from leaf roll in 1942, a few plants were found in it in 1938 and again in 1940 that had the appearance of leaf roll plants; but since the variety had clean readings for 1941 and 1942 it seems likely that these plants were not infected with the leaf roll virus but that the rolling was due to environmental factors.

Fifty-four South American varieties were included in the test in 1936. The 1937 data showed that every one of them had become infected with the leaf roll virus to some degree as shown in table 1. A group of seedling varieties selected for their resistance to late blight from progenies of the German W races were in the same test. Seven out of 60 of these escaped infection in 1936-'37, but there were no escapes in the retest of five of the seven. All of them showed leaf roll in 1939 as you will note in table 1.

Two crosses, Russet Rural x 44537 and Ackersegen x Katahdin, were tested for 4 years, 1937-'40, inclusive. In 1938 approximately 35 per cent of the seedlings of the first and 38 per cent of the seedlings of the second cross showed no signs of infection in comparison with 11 per cent of escapes for the Green Mountain checks. The chi-square test showed that there was no significant difference between the two progenies but that either one of them was not more resistant than the Green Mountain checks, the differences in the latter comparisons being highly significant. In 1938 a total of 123 seedlings in the progenies under discussion showed no signs of leaf roll, but in 1940 only one was still free from the disease.

In 1939 leaf roll data were taken for the cross Albion x Katahdin. It showed a significantly higher degree of resistance than the Green Mountain checks for that year, but when the seedlings that had escaped in 1939 were retested not one of them was found free from leaf roll in 1941 as shown in table 1.

In 15 seedlings of the Imperia x Katahdin cross two were free from leaf roll after 4 years' exposure, and one escaped after 5 years.

The Albion x Earlaine cross was not significantly more re-

TABLE 1.—*Foreign introductions, progenies, and check varieties in the field-exposure leaf roll tests at Beltsville, Md., 1936 to 1942.*

Pedigree or Varietal Name	Year Readings Were Made	Years Grown in Test	Diseased Plants: 0 Per cent	Diseased Plants: 1-20 Per cent	Diseased Plants: 21-40 Per cent	Diseased Plants: 41-60 Per cent	Diseased Plants: 61-80 Per cent	Diseased Plants: 81-100 Per cent	Total Varieties Seedlings or Check Plots
		No.	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
South American varieties	1937	2	0	2	10	17	17	8	54
Selections from German W races	1937	2	7	8	7	11	12	15	60
Do	1939	4	0	0	3	1		1	5
Russet Rural x 44537	1938	2	55	49	40	7	5	3	159
Do	1940	4	1	5	14	7	4	2	33
Ackersegen x Katahdin	1938	2	68	59	26	17	4	5	179
Do	1940	4	0	3	17	7			27
Albion x Katahdin	1939	2	19	35	46	17	5	3	125
Do	1941	4	0	3	8	4	3		18
Imperia x Katahdin	1939	2	3	6	5	1			15
Do	1941	4	2						2
Do	1942	5	1	1					2
Albion x Earlaine	1941	2	4	30	23	4	2		63
Do	1942	3	0	1	2	4	3	1	11
President x Katahdin	1941	2	1	12	31	25	16	6	91
Do	1942	3					1	1	2
Katahdin x Earlaine	1941	2	9	15	5	1			30
Do	1942	3		1	1	2	6	2	12
41956 x Katahdin	1941	2	13	28	19	9	6	1	76
Do	1942	3	1[1]	3	2	1	1		8
41956 x Earlaine	1941	2	1[2]	17	24	19	9	4	74
Katahdin selfed	1938	2	17	7	3	1	1		29
Do	1940	4		1	4	3			8
Green Mountain check	1937	2	0	4	4	5	1		14
Do	1938	2	9	13	15	4	1	38	80
Do	1939	2	0	2	14	16	7	10	49
Do	1940	2	0	2	1	1			4
Do	1941	2	1	12	19	4	1		37
Do	1942	2						3	3

sistant than the Green Mountain checks, as shown by the chi-square test of the 1941 data. Four seedlings of this cross were free from leaf roll in 1941, but in 1942 all seedlings exhibited leaf roll to some degree.

In 1939 it was observed that 271 seedlings grown on the Aroostook Farm for different periods had come through the 1937-'38 epidemic of leaf roll without contracting the disease in a single plant. Ninety-one of these were from the cross President x Katahdin, first grown in 1932; 30 from Katahdin x Earlaine, first grown in 1934; 76 from 41956 x Katahdin, and 74 from 41956 x Earlaine, first grown in 1935. If Green Mountain had been grown under the same conditions and for the same length of time, it is doubtful if a single plant would have escaped. The same 271 seedlings were planted at Beltsville in 1940 in the exposure tests. Twenty-four were still free from leaf roll in 1941, but in 1942 only two of them showed no symptoms. A small progeny of Katahdin selfed was included in the 1937 tests. In 1938 nearly 60 per cent of the seedlings of this line were free from leaf roll, but only 11 per cent of the Green Mountain checks. The chi-square test indicates that the difference between the leaf roll reactions of this progeny and the checks is highly significant.

Leaf roll field-resistance tests have been conducted at Highmoor Farm, Monmouth, Maine, for 5 years, 1938-'42, inclusive. During that time 65 crosses have been exposed to leaf roll infection. Ten of these were exposed for the first time in 1942 so their reaction to the disease cannot be recorded until 1943. Of the remaining 55 crosses a total of 5,518 seedlings have been grown. Of this number 300 or 5.4 per cent did not show leaf roll symptoms in 1942. The test has been rigorous, as is shown by the fact that there was 0.5 per cent leaf roll in the Chippewa checks in 1941 and 90.5 per cent in 1942, after 1 year's exposure. Also, 69 to 87 per cent of the healthy seedlings exposed each year have become infected.

Among the most promising crosses were Kepplestone Kidney x Earlaine, Imperia x Earlaine, 47483 x 47156, and selfed lines of the following seedlings: B 127, 47562, 96-99, and 926-36.

The most encouraging feature of the tests at Highmoor Farm is that the greatest resistance to infection in 1941 was found in the seedlings remaining healthy through the exposures of 1939 and 1940. Most of these showed a light infection, if any, whereas a large number of the seedlings exposed for the first time in 1941 showed a heavy infection.

Net Necrosis

No systematic tests have been made to determine the breeding

behavior of the tendency of the tubers to develop net necrosis as the result of current season's infection with the leaf roll virus. Observations over a period of years indicate, however, that some of the varieties that have been recently distributed do not contract this malady. Katahdin, Chippewa, and Sebago have been grown on thousands of acres, but only once has there been a suspicion of the development of net necrosis in their tubers. This occurred in the 1940 Beltsville tests when a heavy epidemic of stem-end browning developed in all the plots on the farm, not only in the leaf roll but also in the spindle-tuber and leafhopper tests. Some of the more severe cases were diagnosed from the symptoms as net necrosis, but whether or not they were infected with the leaf roll virus was not ascertained.

Prospects

The results of the leaf roll-resistance tests to date have failed to show immunity from the disease. That some varieties and progenies become infected less readily than others is quite evident. Foreign varieties, such as Albion, Friso, West Brabander, Triumf, Bevelander, Noordeling, Imperia, Kepplestone Kidney, and Shamrock (introduced because of their reported resistance to leaf roll) do not seem to become infected so quickly as Green Mountain, but under continual exposure they sooner or later get the disease. Triumf is the only one that seems to be free from leaf roll after 5 years' exposure.

Among the American commercial varieties Katahdin and Houma seem to show resistance. A number of progenies that have been more resistant than Green Mountain have been related to Katahdin. They are: Russet Rural x 44537[1], Ackersegen x Katahdin, Albion x Katahdin, 41956 x Katahdin, Katahdin x Earlaine, President x Katahdin, Imperia x Katahdin, and Katahdin selfed (table 1). A few others that were in the test at Highmoor Farm, Monmouth, Maine, and that also showed some indication of resistance, were related to foreign introductions. Among these were Kepplestone Kidney x Earlaine, and Imperia x Earlaine. It is hoped that some of the latter may carry factors for resistance different from those in Katahdin, and that transgressive inheritance may operate to produce varieties more resistant than anything we have at present. It is conceivable, too, that varieties such as Katahdin are simplex or perhaps duplex for resistance and that by a series of selfings, sib-matings, and backcrossings it may be possible to get plants that are triplex or even quadruplex, and correspondingly more resistant to the attacks of the disease.

It might seem that a character which prevents a rapid virus infection is unimportant, but a variety with such a character could be

[1]44537 = Chippewa x Katahdin.

grown with less labor and loss than the Green Mountain or Chippewa, the leaf roll in either of which has been known to increase from less than 5 per cent to nearly 100 per cent in 1 year's exposure. It is important, too, to develop varieties that do not get net necrosis as a result of the current season's infection. This last seems a rather easy undertaking, since a number of the varieties that have been newly distributed in recent years are of that type.

Summary

Leaf roll has become a serious menace in some of the best potato-growing sections of the United States. In varieties such as Katahdin the loss is in reduction of yield resulting from the rolling and yellowing of the leaves and the dwarfing of the plants. In varieties such as Green Mountain the development of net necrosis in the tubers causes additional losses. The virus is spread by aphids, and the amount of spread in any one year is dependent to a large extent on the severity of the aphid infestation. Prior to 1937 the incidence of leaf roll could be held to a minimum in Maine by isolation, roguing, and early-harvesting. In that year a heavy infestation of aphids caused a correspondingly heavy spread of the disease, and since no practical methods of aphid control have yet been devised it became evident that the problem would have to be solved by breeding leaf roll-resistant varieties.

A number of European workers have reported on breeding for resistance to this virus. Several of the varieties mentioned in the reports have been introduced and are being used as basic material for the present breeding program.

Two methods of testing were practiced in the earlier trials: tuber-grafting and field-exposure. It was soon seen that the first method was too severe to demonstrate the differences in resistance that were present in the available varieties, so in recent years only the field-exposure tests have been made. The work has been done at three stations: Aroostook Farm, Presque Isle, Maine, Beltsville, Md., and Highmoor Farm, Monmouth, Maine.

The European introductions have been tested at Beltsville, but by continual exposure over a period of years they have with one exception, Triumf, become infected to a certain degree. Fifty-four South American varieties planted in the exposure test in 1936 showed some leaf roll in 1937. Seven of the 60 selections made from the German W races from Berlin-Dahlem escaped infection in 1936-'37. Five of these were retested, but there were no escapes in the second test. A number of progenies related to Katahdin all showed a much higher

degree of resistance than the Green Mountain, but by repeated exposure these seedlings became infected.

During 5 years, 1938-'42, 55 progenies consisting of 5,518 seedlings have been tested at Highmoor Farm. Three hundred of these showed no leaf roll in 1942.

Breeding for resistance to net necrosis has not been undertaken, but a number of the new varieties, Katahdin, Chippewa, and Sebago, very seldom, if ever, contract this malady.

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STEM-END VASCULAR DISCOLORATION OF POTATOES DUE TO *FUSARIUM OXYSPORUM, f. tuberosi.*

E. J. PETERS[1]

Research Department Weyl-Zuckerman & Co., Stockton, Cal.

Due to price ceilings on potatoes resulting in a substantial discount when grades fall below a U. S. No. 1, stem-end vascular discoloration has become more and more important. Then, too the needs of the war effort have greatly increased the importance of securing maximum yields. The elimination of any undesirable potatoes in seed lots is greatly to be desired. Dietitians are also stressing the higher food values to be found in potatoes that are not internally discolored.

In an attempt to evaluate some of the probable causes of stem-end

[1]The author wishes to express his gratitude to Drs. M. W. Gardner and P. A. Ark of the Division of Plant Pathology of the University of California, for their advice and kindness in permitting the use of laboratory facilities which have made this investigation possible.

vascular discoloration, cultures were made of a large quantity of White Rose seed potatoes, grown in the Stockton Delta in 1941. The tissues underlying areas of stem-end discoloration vary in their discoloration and consistency, depending on the fungi causing these conditions. The color of the affected vascular tissues varies from light to dark brown to a deep black. Sometimes, as reported by Shapovalov and Link (1) more than one species of fungi attacks the same tuber causing a combination of different types of dry rot. According to Sherbakoff and Goss (2, 3) the matter of identification is also very important.

Agar cultures proved that from 426 tubers, selected for stem-end vascular discolorations, 380 were infected with *Fusarium oxysporum* (SCHLECHT), *f. tuberosi*, and 28 doubtful cases were examined and identified by Dr. Wm. C. Snyder as *Fusarium oxysporum, f. tuberosi.*

The 380 infected tubers were planted in 1942 cutting each tuber in 3 seed pieces, each seed piece weighing nearly one ounce. As a control a similar quantity was planted from seed tubers that produced negative results when cultured.

The plants from the infected tubers showed vascular stem discoloration. All these plants varied in height. Many of them wilted early in the season. After the progenies of both groups were harvested, they were examined for stem-end vascular discolorations and the following data were secured.

	Grown from Seed Tubers Infected with *Fusarium oxysporum f. tuberosi*		Grown from Clean Seed Tubers	
	Tubers	Per cent	Tubers	Per cent
Clean	37	3.4	1377	83.9
Slight Discoloration....	134	12.2	168	10.2
Medium Discoloration.	404	36.9	71	4.3
Heavy Discoloration...	421	47.5	26	1.6
	1096	100.0	1642	100.0

Slight discoloration not more than ½ inch deep
Medium discoloration to ⅓ of tuber
Heavy discoloration greater than ⅓ of tuber.

Yield Data:
From Fusarium-infected seed 0.8 lbs. per hill, equal to 201 sacks per acre (100-pound sacks).
From clean seed 1.3 lbs. per hill, equal to 326 sacks per acre.

Nearly 60 per cent of the potatoes grown from Fusarium-infected seed tubers would not pass U. S. Grade specifications on account of

stem-end vascular discoloration. Practically all potatoes grown from clean seed would pass U. S. grade.

Therefore the economic loss caused by the use of seed showing *Fusarium oxysporum, f. tuberosi* is almost 80 per cent.

Six hundred and ninety-six of these tubers were cultured again as a control and *Fusarium oxysporum, f. tuberosi* was reisolated in each case. Slight, medium or heavy discoloration did not make any difference, whereas the clean tubers were sterile. These results seem to prove that there was a carry-over of vascular discoloration in the group grown from Fusarium-infected tubers, compared with the group that cultured negatively and showed no discoloration. This corroborates the work of Goss (3) and many of our earlier investigators. It should be borne in mind that sometimes discolored vascular tissues in the stem-end of tubers is sterile, and at other times it is caused by *Verticillium alboatrum* or other fungous organisms.

It is therefore apparent that it would be wise to remove all tubers that may be infected with *Fusarium oxysporum, f. tuberosi* from all foundation seed stocks. Iverson and Kelly (4) have found that the use of the ultraviolet-light method developed at the Montana Agricultural Experiment Station also aids greatly in this work.

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THE VALUE OF ORGANIC MATTER AND IRRIGATION IN THE PRODUCTION OF POTATOES IN ALABAMA

L. M. WARE

Alabama Agricultural Experiment Station, Auburn, Ala.

Agricultural programs in the South have been based on the assumption that fertilizers must be used to produce profitable crops. It

has also been recognized that the addition of organic matter to the soils of the South is highly desirable if satisfactory levels of soil fertility are to be maintained. Less attention has been given to irrigation as a factor in crop production. For field crops it is not likely that irrigation would prove profitable. However, for more intensively handled truck crops it would seem possible that irrigation might offer good returns under certain conditions. The high cost of installing irrigation systems and the expense of irrigating crops make it quite necessary that the conditions be known under which irrigation increases yields sufficient to justify costs.

The Alabama Agricultural Experiment Station began studies in 1930 at Fairhope in the commercial potato section to determine the influence of green manures on the yield of six different truck crops. Experiments have been continued twelve years with Irish potatoes. In 1938 studies were started at the Main Station, at Auburn, to determine the value of organic matter and irrigation for truck crops. The results of some of these studies have been previously reported (1, 2, 3, and 4). Certain phases of the studies with Irish potatoes will be reported in this paper.

The studies at Fairhope were made on field plots and at Auburn in concrete bins with thoroughly composited soil. The organic matter was grown in place and turned under at Fairhope. With minor variations, *Lespedeza sericea* was introduced in the bins, at Auburn, for all treatments except those marked "B" for vetch and "C" for cowpeas. Three tons of dry Lespedeza were added three times annually for the first two years; for later years two tons of dry Lespedeza were added in the spring and six tons of green material added in the fall. Irrigation was given at the rate of one inch per week if rainfall did not supply approximately this amount.

Value of Irrigation

Opinions regarding the value of irrigation in the South have ranged from that which maintains that no irrigation is necessary with 50 to 60 inches of annual rainfall to that which assumes that with irrigation available greatly increased yields can be assured. The data show that there is a definite limit to the value of irrigation and that its value is greatly affected by other factors.

Value of Irrigation for Spring Potatoes—

At Auburn on plots receiving no organic material, little or no increases were obtained in the yield of spring potatoes for irrigation in 1938, 1939, and 1940 as is shown in (table 1). Rainfall was about normal

TABLE 1.—*Yield of spring potatoes receiving different rates of fertilizers with and without irrigation and organic matter added.*

Main Station, Auburn.

Treatment			Yield in Bushels per Acre—All Grades				
Pounds (1) per Acre Fertilizer	Irrigation (2) Inches per Week	Organic* Material (3)	1938	1939	1940	1941	Average
0	0	0	94	14	2	3	28
500	0	0	161	72	38	51	81
500	1	0	127	67	45	88	82
500	0	added A	149	103	137	157	137
500	1	added A	150	161	200	195	177
1000	0	c	181	106	71	101	115
1000	1	0	175	95	84	167	130
1000	0	added A	169	120	166	191	162
1000	1	added A	189	179	266	283	229
1000	0	0	179	81	71	101	108
1000	2	added A	203	135	253	309	225
1000	1	turned B	—	—	340	191	266
1000	1	turned C	209	195	131	221	189
1000	0	0	197	138	82	100	129
Inches rainfall added			—	7	4	6	6

(1) Pounds per acre of a fertilizer analyzing 6-8-4 (NPK)
(2) Inches irrigation applied each week if rain did not supply approximately this amount
(3) *Organic material
A—Lespedeza sericea introduced
B—Vetch grown in position
C—Cowpeas grown in position.

during these years. A satisfactory increase in yield was obtained in 1941, a year of low rainfall, (table 2). The average increase in yield

TABLE 2.—*Rainfall data for years involved. Auburn, Alabama*

Month	Normal Rainfall	Rainfall by Months				
		1938	1939	1940	1941	1942
March	5.77	4.82	7.07	7.91	4.02	8.84
April	4.38	10.73	4.30	2.53	3.04	2.22
May	3.75	4.13	2.86	2.92	0.84	4.00
August	4.68	3.28	9.33	3.33	5.21	6.05
September	3.18	2.02	4.00	0.90	2.92	3.80
October	2.99	0.31	0.10	0.26	2.62	2.30

for irrigation over the four-year period was only 15 bushels per acre at the 1000-pound-per-acre rate of fertilizer application. There was no increase at the 500-pound-per-acre rate.

Although there was very little increase in yield for irrigation without the addition of organic material, there were material increases in the yield of spring potatoes for irrigation at both rates of fertilizer applications on plots receiving organic material. On plots receiving 500 pounds per acre of fertilizer and organic material an average increase of 40 bushels per acre was obtained for irrigation over the four-year period; the increase has been 53 bushels for the past three years. At the 1000-pounds-per-acre rate of fertilizer application, an average increase in yield of 67 bushels per acre was obtained for irrigation over the four-year period; the increase has been 84 bushels per acre for the past three years.

The value of irrigation in the spring was thus greatly affected by the presence or absence of organic material and by the amount of fertilizer applied. Without organic material added, irrigation gave little benefit; with organic matter, a marked increase was obtained. With organic material added, the low rate of fertilizer application gave a material increase in yield; the higher rate, however, gave an even greater increase in yield.

Value of Irrigation for Fall Potatoes—

Irrigation, independent of organic matter, appears to have exerted a greater influence on the production of fall potatoes than on the production of spring potatoes. Fall potatoes are planted in Alabama during July and August. They develop during September and October.

Rainfall during this period is usually low, temperatures are high, and soil moisture is generally deficient. Yields thus might be expected to be affected more by irrigation in the fall than in the spring.

In the experiments at the Main Station, irrigation, independent of organic material, gave an average increase in the yield of fall potatoes of 31 bushels per acre for the three-year period. This represented an increase in yield of 76 per cent as shown in table 3. Irrigation used with stable manure gave an average increase in yield of 61 bushels per acre; this represents an increase of 117 per cent. On plots where vetch had been turned in the spring and an intervening summer crop grown, irrigation gave an increase in yield of 35 bushels per acre, equivalent to 81 per cent. Where manure was added and vetch also turned, irrigation was responsible for an increase in yield of 66 bushels per acre or an increase of 127 per cent.

Irrigation, as an independent factor, thus gave much larger relative increases in the yield of fall potatoes than of spring potatoes. The amount of the increase was greater, however, when irrigation was used with the stable manure than when used alone.

Value of Organic Material

The records indicate that organic material is relatively of greater importance than irrigation in the production of spring potatoes, whereas irrigation is of greater importance than organic matter in the production of fall potatoes when each factor is considered independent of the other.

Value of Organic Material for Spring Potatoes—

Quite different from irrigation, organic matter as an independent factor gave a material increase in yield of spring potatoes. In the experiment at the Main Station, with 500 pounds of fertilizer per acre, organic material added without irrigation gave an increase of 56 bushels per acre, or an increase in yield of 69 per cent (table 1). With 1000 pounds of fertilizer added, organic material gave an increase in yield of 47 bushels per acre, or 41 per cent.

Although organic material gave large increases in the yield of spring potatoes when used without, it gave still larger increases in yield when used with, irrigation. On irrigated plots the yield of spring potatoes was increased 95 bushels per acre by the addition of organic material or was increased 116 per cent at the 500-pound rate of fertilizer application; at the 1000-pound rate the increase in yield was 99 bushels, or 76 per cent.

In the case of both organic material and irrigation the value of

TABLE 3.—*Yield of fall potatoes receiving different rates of fertilizers, different types of organic matter and irrigation*

Main Station, Auburn

Treatment			Yields in Bushels per Acre—All Grades			
Rate of (1) Fertilizer	Organic (2) Matter Added	Irrigation Supplied (3)	1940	1941	1942	Average
0	0	0	7	7	19	11
1000	0	0	28	16	78	41
1000	12 tons manure	0	21	18	116	52
1000	0	1	76	37	103	72
1000	12 tons manure	1	118	67	154	113
1000	vetch turned	0	8	31	91	43
1000	vetch turned	1	76	54	103	78
1000	rye turned	0	11	25	83	40
1000	rye turned	1	81	35	107	74
1000	0	0	12	28	70	37

TABLE 3.—*Yield of fall potatoes receiving different rates of fertilizers, different types of organic matter and irrigation*—(Continued)
Main Station, Auburn

Treatment			Yields in Bushels per Acre—All Grades			
Rate of (1) Fertilizer	Organic (2) Matter Added	Irrigation Supplied (3)	1940	1941	1942	Average
1000	12 tons manure vetch turned	0	25	24	108	52
1000	12 tons manure vetch turned	1	123	71	161	118
1000	6 tons manure vetch turned.	1	95	48	135	93
1000	6 tons manure rye turned	1	91	51	121	88
1000*	12 tons manure vetch turned	1	129	66	145	113
1500	12 tons manure vetch turned	1	150	76	159	128
2000	12 tons manure vetch turned	1	153	65	153	124
Inches rainfall supplied						

(1) Pounds per acre 6-8-4 (NPK) applied to each of two crops grown each year
(2) Manure added each year. Vetch planted at time of last cultivation of fall crop and turned 10 days to 2 weeks before crop planted in spring
(3) Acre inches added if rain did not supply approximately this amount.

each was increased more when they were used in combination than when used alone.

The use of introduced organic material may have considerable practical value on small garden areas. However, to be of most practical value on large areas, organic material should be grown in position. The value to spring-grown potatoes of vetch grown in position as a winter legume crop and of cowpeas grown in position as a summer legume crop is shown in the experiment at the Main Station (table 1).

Although spring crops were grown only two years on the vetch plots, the yield in 1940 on the vetch plots receiving irrigation was 340 bushels per acre. This was an increase of 256 bushels more than was produced on the plots receiving irrigation alone, and was the highest yield of any treatment for that year. The yield of the vetch plot in 1940 was 74 bushels higher than the yield of the corresponding plots receiving introduced Lespedeza. In 1941, the vetch plots gave a yield of 24 bushels per acre more than the plot receiving irrigation alone but 92 bushels below the plots receiving Lespedeza. It should be explained that spring potatoes were necessarily planted later on plots receiving vetch than the other plots, a practice which under normal conditions will result in greatly reduced yields.

Cowpeas grown each summer prior to the potato crop with an intervening crop of fall turnips have given, with irrigation, an average increase of 59 bushels per acre over irrigation alone (table 1). At Fairhope, on land which at the beginning of the experiment had been recently cleared and was, therefore, high in organic matter, the average increase in yield of spring potatoes during a 10-year period for summer legumes was only 6 bushels per acre where a full application of nitrogen had been applied (table 4). It should be noted, however, that the increase for the eleventh year was 20 bushels for this treatment. The increase in yield for the summer legume on plots not receiving nitrogen was 36 bushels for the 10-year period and 54 bushels for the eleventh year. It is probable that the low value of the added organic material at Fairhope was caused by the relatively high organic matter in the newly cleared land.

A point of interest is found in the very rapid loss of the value of the legume on the plots receiving legumes but no nitrogen after the practice is discontinued (table 4). Although approximately 10 tons of crotalaria had been turned annually for 10 consecutive years in Series A the omission for one year of the legume crop was responsible for a drop in yield of 54 bushels per acre when compared with the corre-

TABLE 4.—*Yield of potatoes with different rates of nitrogen with and without organic matter. Fairhope, Alabama.*

Yield Marketable Potatoes

Fertilizer Treatment (1)	First 10-Year Period		Transition Year Yield Bushels per Acre (2)	First Year after Transition			
				Series A		Series B	
	Organic Treatment	Yield Bushels per Acre 10-Year Average		Organic Treatment	Yield Bushels per Acre	Organic Treatment	Yield Bushels per Acre
6 - 10 - 6	non-legume removed	218	156	non-legume removed	172	non-legume removed	170
0 - 10 - 6	non-legume removed	126	74	non-legume removed	61	non-legume removed	62
0 - 10 - 6	legume turned	162	128	non-legume removed	81	legume turned	135
3 - 10 - 6	legume turned	220	183	non-legume removed	167	legume turned	180
6 - 10 - 6	legume turned	223	176	non-legume removed	184	legume turned	185
6 - 10 - 6	non-legume removed	217	156	non-legume turned	187	non-legume turned	182

(1) Fifteen hundred pounds per acre of an x - 10 - 6 (NPK) fertilizer.
(2) Change in organic treatment occurred after potatoes were grown; the potato crop grown first year after transition was the first crop to reflect change in the organic treatment. Treatments in Series A and series B were identical during the first 10 years.

sponding plot in Series B which had grown the usual crop of legume the summer before. The treatment history of Series A and Series B was identical for the first 10 years. The yield of the plots which had missed a legume crop only one year after having had a legume crop turned each year for 10 years was within 20 bushels of the yield of the plot which had received no legume during the previous 10-year period (Series A). The difference in the yield of the corresponding plots in Series B was 73 bushels, the only difference being that the plots in Series B had received a legume the year before, whereas the corresponding plots in Series A had not.

Value of Irrigation and Organic Material Combined

The data which have been presented indicate that although increases in yield have been obtained from the use of irrigation and organic matter, each used separately, it has only been when the two have been combined that maximum yields have been produced and greatest value obtained for each practice. This general relationship has held for both spring potatoes and fall potatoes, and for high and low rates of fertilizer applications.

The average yield at the Main Station for the four-year period of spring potatoes which received 1000-pounds per acre of fertilizer without irrigation or organic material was 115 bushels to the acre, (table 1). Irrigation without organic material increased the yield 15 bushels per acre or 13 per cent. Organic material without irrigation increased the yield 47 bushels per acre or 41 per cent. Irrigation and organic material combined increased the yield 114 bushels per acre or 99 per cent. In 1941 a year of low rainfall and one occurring after the system had been operating long enough presumably for the fertility level of the soil to have been somewhat affected by repeated applications of organic matter, the differences in yield for the different treatments were quite pronounced. The average yield of potatoes this year with 1000 pounds of fertilizer applied per acre was 101 bushels per acre. Irrigation without organic material increased the yield 66 bushels per acre or 65 per cent. Organic material without irrigation increased the yield 90 bushels per acre or 89 per cent. The two treatments combined increased the yield 182 bushels per acre or 180 per cent. Similar results were obtained for the spring crop at the lower fertilizer rate and also for the fall crop.

Productivity Trends

The experiment in the bins carrying spring potatoes covers a

period of only four years. This is too short a period to give an idea of the ultimate levels of fertility reached under the several treatments; however, some trends seem to be definite enough to deserve mention.

The yield of potatoes in plots receiving no fertilizers progressively dropped from 94 to 14 to 2 to .3 bushels per acre during the four-year period. The relatively high yield the first year was naturally caused by the residual effects of past fertilizer applications to previous crops (table 1). The yields of plots receiving 500 pounds of fertilizer per acre without organic material were 161 bushels the first year and 51 bushels the fourth year; at the 1000-pound-per-acre rate of fertilizer application, the corresponding yields were 181 bushels the first year and 101 bushels the fourth year. In contrast to this trend in yield of plots receiving no organic material, the yields of plots receiving organic material for the first and fourth years were 149 bushels and 157 bushels per acre, respectively, at the 500-pound-per-acre rate and 169 bushels and 191 bushels, respectively, at the 1000-pound-per-acre rate. Even though the actual yields for the first and fourth years have little significance, the relative yields, during this period, of plots receiving the same treatment offer at least some indication of trends under the several treatments. The yield of plots receiving no organic material had materially decreased in all cases; those receiving organic material had increased.

Summary

The results of the several experiments reported here indicate that the value of irrigation and of organic material is greatly affected (1) by the time of the year the practice is applied, (2) by the amount of fertilizer used, (3) climatic factors for a given year, (4) the level of organic matter in the soil, and (5) by the use or the omission of, the other practice together with the one being studied.

In general, it appears (1) that irrigation may be of greater value to potatoes in the fall than in the spring, (2) that organic matter may have a greater influence in the spring than in the fall, and (3) that organic matter may affect the yield of potatoes much more than irrigation in the spring, whereas irrigation may affect the yield more than organic matter in the fall.

The data indicate rather definitely that although irrigation and organic material added separately may each increase yields, the full value of each is obtained only when the two are combined.

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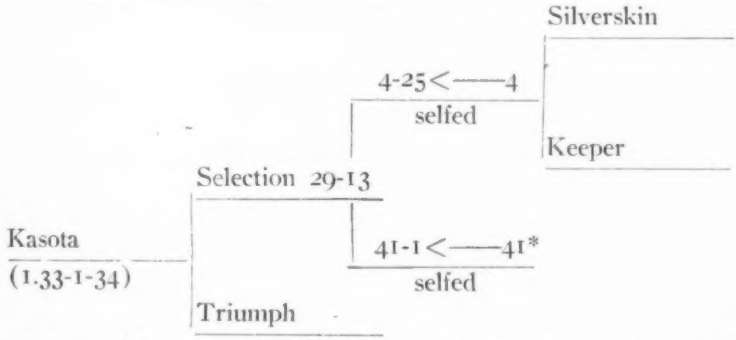
THE KASOTA POTATO[1 2 3 4]

F. A. Krantz and A. G. Tolaas
Minnesota Agricultural Experiment Station, University Farm, St. Paul, Minn.

AND

H. O. Werner, H. W. Goss and J. H. Jensen
Nebraska Agricultural Experiment Station, Lincoln, Nebr.

The "Kasota" variety of potatoes is being jointly introduced by the Minnesota and Nebraska Agricultural Experiment Stations. It was obtained from a cross between a seedling selection 29-13 and Triumph. The ancestry is indicated by the following chart:



*Seed obtained from grower who reports collecting it in a field of Early Ohio.

[1]Paper No. 2061 Scientific Journal Series, Minnesota Agricultural Experiment Station. Paper No. 329 Journal Series, Nebraska Agricultural Experiment Station.

[2]Kasota is an Indian word indicating "a clearing", and was selected because it contains the last syllables of the names Nebraska and Minnesota.

[3]The Kasota variety is the result of breeding work by the Minnesota and Nebraska Agricultural Experiment Stations in cooperation through the National Potato Breeding Program with the United States Department of Agriculture and other state experiment stations.

[4]The general information in this paper on the characteristics of the Kasota variety will be supplemented by more detailed experimental data concerning the characteristics and performance of this variety soon to be published by each of the two experiment stations.

The cross between Triumph and selection 29-13 was made at Minnesota in 1933. Selections were made in 1934 and placed among other selections in a test plot in 1935. Both stations testing this material independently, since 1935, selected 1.33-1-34 as worthy of introduction.

Description

Plants dark green, medium to large, compact; stems thick angled, slightly winged at leaf juncture; nodes very slightly smaller; and internodes tinged with red. Leaves glabrous, medium long, broad, midrib green with a tinge of red in axils of primary leaflets; primary leaflets dark green, close, four pairs, large, medium long, broad, mean length 89.7 mm., mean width 57.3 mm., index w/l x 100, 63.9; petioles dark green; secondary leaflets numerous; tertiary leaflets few to many.

Inflorescence axillary, often rudimentary; leaf bracts absent; peduncles short, dark, pubescent, reddish abscission layer; flowers few, buds mostly abscising before opening; calyx dark green, pubescent, lobes short; corolla medium to small, light lavender; anthers small, pale yellow; pollen scant, sterile; style straight; stigma globose, multilobed; dark green.

Tubers broadly roundish, flattened, usually wider than long, with medium thickness; skin smooth, medium red; eyes shallow, slightly indented at seed end; flesh white; sprouts tinged with red at tip; maturity midseason.

Cooking Quality

Kasota tubers cook very much like Triumph; that is, they hold together well when boiled, but are not so mealy as the Cobbler or Russet Burbank. Flavor and color when cooked are similar to Triumph. Generally, they have been rated slightly higher in texture (more mealy), flavor, and color than Triumph but never so high as Cobbler. They cook as well as or superior to Katahdin and Chippewa.

Reactions to Disease

The Kasota has been tested for six years in a field heavily inoculated with *Fusarium solani* v. *eumartii* in Nebraska, and in five of the six years only one-third as many tubers have shown stem-end rot and vascular discoloration as Triumph and Cobbler.[5] The results were inconclusive in one year due to a slight yellowing and darkening of the

[5]The detailed results of two years of these tests are included in a paper by R. W. Goss and J. H. Jensen, "Varietal susceptibility of potatoes to Fusarium wilt," in the American Potato Journal 18 (7): 209-212, 1941. The Kasota variety was listed as B5.

vascular system extending less than one-half inch into the tuber that was not easily distinguished from *Fusarium* infection. Five years of testing in Nebraska in a very scabby soil showed the variety to be as susceptible to scab as the Triumph when judged by the area infected but the scab pustules were seldom of the deep or pitted type. Observations in Minnesota indicate that Kasota may be somewhat less susceptible to late blight than the commonly grown varieties. The variety was found to have about the same degree of susceptibility to spindle tuber as other commercial varieties in field plantings in Nebraska and in experimental tests when planted alternately with spindle-tuber plants.

Adaptation

The Kasota variety appears to be well adapted to locations favorable to a midseason variety. In Minnesota it matures earlier than the Chippewa and Pontiac, and later than the Triumph and Cobbler. In Minnesota it has offered the most promise in the Red River Valley where many growers may find the variety more satisfactory than the Early Ohio and Cobbler in yield, per cent marketable tubers and in quality of product for the table market. It has grown well in western Nebraska with irrigation. Because of being later than Triumph it should be planted earlier than that variety—probably from the 7th to the 15th of June instead of from the 15th to the 25th. It is very heat enduring and the plants survive drought better than Triumph or most other varieties, but further testing is needed to determine adaptability for dry land, especially to determine whether tubers that are sometimes set quite abundantly develop to adequate size. In Alabama and South Carolina, yields of U. S. No. 1 potatoes have been very good (one test each place—1941). It is not recommended as an early potato for cornbelt conditions. It may be suitable as a late potato in the regions that are a little too warm for general or commercial production of a late potato crop.

Dissemination

Agricultural Experiment Stations may receive small quantities of foundation seed stock from the Horticulture departments of either the Minnesota or Nebraska Agricultural Experiment Stations. Any one else interested in procuring seed stocks of this variety should communicate either with A. G. Tolaas, Potato Seed Certification, St. Paul, Minnesota; or Marx Koehnke, Seed Potato Certification Manager, Nebraska Certified Potato Growers' Cooperative, Alliance, Nebraska.

STUDIES ON THE ASSOCIATION OF HEAT SPROUTING WITH REST PERIOD AND MATURING TIME IN IRISH POTATOES[1]

E. L. LeClerg and M. T. Henderson[2]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, Baton Rouge, La.

Heat sprouts frequently occur in Irish potatoes in the warmer portions of many of the Southern States, being particularly prevalent in late-harvested potatoes. It seemed desirable, therefore, to investigate this problem, particularly with reference to the association of heat sprouts with maturity and rest period.

Description of Heat Sprouts

Heat sprouting (Fig. 1) is the growth of tuber buds (usually the apical buds) prior to harvesting, and is assumed to be due to a combination of high soil temperature and low soil moisture. Heat sprouts are frequently prevalent in many seedling varieties and some varieties at Baton Rouge, Louisiana, particularly when harvested shortly after the twenty-fifth of May. It is not unusual for hot and dry weather conditions to prevail for a week to ten days prior to this date. Marked differences also have been noted in the prevalence of heat sprouts in segregating progenies. The fact that this phenomenon is influenced to such an extent by temperatures and moisture fluctuations, however, makes a study of its inheritance difficult.

Methods and Materials

The crossed and inbred lines of true seed were produced under field conditions at Baton Rouge, Louisiana without emasculation or bagging of the flowers. In making the pollinations, care was taken to use only those flowers whose anthers were not ready to dehisce. Naturally pollinated seed of the Katahdin and inbred Triumph parents was used.

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[1]The investigations herein reported were conducted by the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, United States Department of Agriculture in cooperation with the Department of Horticulture of the Louisiana Agricultural Experiment Station.

[2]Pathologist and formerly agent, respectively, of the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, United States Department of Agriculture; stationed at Baton Rouge, Louisiana.

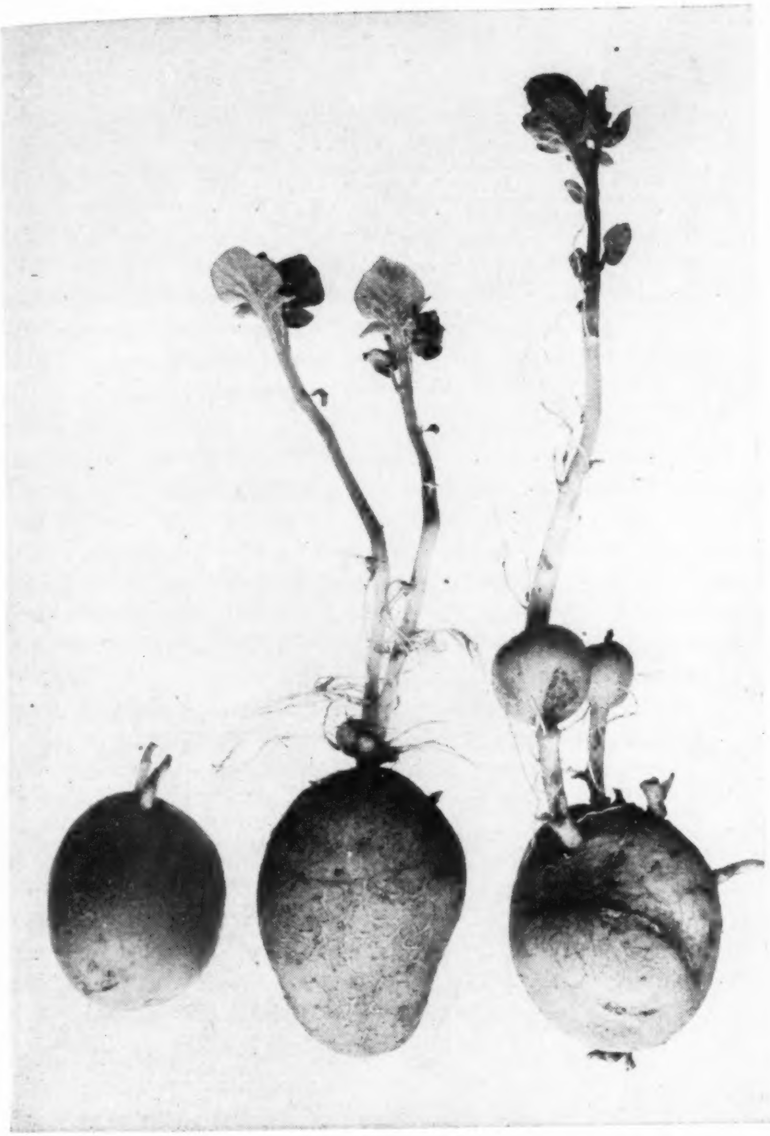


FIGURE 1.—Three stages of development of heat sprouts of Irish Potatoes.

The true seed was harvested during the last two weeks of May, 1940, then cleaned and stored until the middle of July, when it was planted in steamed soil in metal flats. From the middle of August to the middle of September the seedling plants were transplanted to 4-inch pots.

Single tubers from each segregate of each progeny were harvested about the first week in December, 1940. These single-tuber segregates were stored at approximately 75° to 80° F. until spring. At this time they were planted in the field and all received comparable fertilization and cultivation.

The spring harvest was made when the individual plants, as a whole, were advanced enough to allow satisfactory designation as to maturity. In determining the response of a given progeny, each plant was classified according to maturity and presence or absence of heat sprouts.

For the rest period study, three medium-sized field-grown tubers of each segregate were placed in small Kraft paper bags at harvest, and these were stored in a large room (temperature, 70° to 75° F.) on the 14th of June, 1941. After December 1941, bi-weekly observations were made of each segregate to determine those that had sprouted. The date of sprouting was recorded for each segregate, and the period from date of harvest to sprouting was considered the length of the rest period. Accordingly, each segregate was classified in one of three types of rest period: short, medium, or long.

Relation of Rest Period to Presence of Heat Sprouts

It is well known that the tubers of most varieties of potatoes do not sprout for several weeks after harvest. The interval of time during which there is no visible evidence of sprouting is the dormancy period. It is generally considered to be composed of a rest period in which the tuber eyes do not respond to favorable growth conditions, and a subsequent period in which the tubers remain unsprouted only if unfavorable conditions for growth prevail. The results herein discussed are concerned only with the rest period.

The percentage distribution of seven progenies studied with reference to the association of heat sprouting with length of rest period is presented in table 1. It is apparent that the presence of heat sprouts is in inverse ratio to the relative length of rest period. Therefore, the greatest percentage of heat sprouting was associated with short-rest period and the smallest percentage with long-rest period. In the cross of Katahdin x Inbred Triumph, however, the percentage of heat sprout-

TABLE 1.—*Relation of length of rest period to the presence of heat sprouts in potatoes*

Parentage	Length of Rest Period	Total Number of Segregates	Segregates Developing Heat Sprouts	
			Number	Percentage
CROSSES				
Irish Cobbler x Inbred Triumph	Short	167	95	56.9
	Medium	217	93	42.8
	Long	23	7	30.4
Chippewa x Inbred Triumph	Short	57	27	47.4
	Medium	162	60	37.0
	Long	38	14	36.8
Inbred Triumph x Katahdin	Short	41	33	80.5
	Medium	122	59	48.4
	Long	31	7	22.6
Katahdin x Inbred Cobbler	Short	18	14	77.8
	Medium	59	28	47.4
	Long	13	7	53.8
OPEN POLLINATED				
Inbred Triumph	Short	54	47	87.0
	Medium	125	63	50.4
	Long	21	8	38.1
Katahdin	Short	17	10	58.8
	Medium	55	20	36.4
	Long	11	3	27.3
SELFING				
Chippewa	Short	15	7	46.7
	Medium	101	24	23.8
	Long	34	7	20.6
Total or Average	Short	369	233	63.1
	Medium	841	347	41.3
	Long	171	53	31.0

ing was slightly greater with the long-rest period than with the medium-rest period. The difference is small (6.4 per cent), and had a larger population been studied probably this inconsistency would not have occurred.

From the average of the seven progenies, it is clearly evident that the presence of heat sprouts was greatest in the segregates of shortest rest period. Those segregates with longest rest period were less subject to this condition.

TABLE 2.—*Relation of maturity to the presence of heat sprouts in potatoes*

Parentage	Total Number of Segregates	Segregates Developing Heat Sprouts, Classed According to Time of Maturing					
		Early-maturing		Intermediate-maturing		Late-maturing	
		Number	Percentage	Number	Percentage	Number	Percentage
CROSSES							
Triumph x Katahdin	123	2	1.6	10	8.1	16	13.0
Inbred Triumph x Katahdin	75	0	0.0	9	12.1	21	28.0
Garnet Chili x Katahdin	34	0	0.0	4	11.8	7	20.6
Ackersegen x Inbred Triumph	26	0	0.0	8	30.8	8	30.8
Katahdin x Inbred Earlaine	21	1	4.8	2	9.5	3	14.3
Irish Cobbler x Inbred Triumph	17	0	0.0	2	11.8	5	29.4
Sebago x Inbred Triumph	29	0	0.0	5	17.2	6	20.7
SELFINGS							
Chippewa x Inbred Triumph	108	2	1.8	16	14.8	29	26.8
Chippewa x Inbred Triumph	17	0	0.0	3	17.6	3	17.6
Inbred Triumph x Chippewa	48	1	2.1	8	16.7	9	18.7
Total or Average	498	6	1.2	67	13.4	107	21.5

Relation of Maturity to Heat Sprouts

The degree of association between time to maturity and the presence of heat sprouts are given in table 2.

From the study of 7 cross- and 3 inbred-progenies, it is evident that heat sprouts were not very prevalent in early-maturing segregates. Heat sprouts were most prevalent in late-maturing plants and intermediate in plants intermediate in time of maturing. Therefore, it is apparent that the presence of heat sprouts is directly and positively associated with maturing time, from earliness to lateness.

Summary

The studies herein reported were made to determine the degree of association of heat sprouts in Irish potatoes with time of maturing and rest period.

The presence of heat sprouts was found to be in inverse ratio to the relative length of rest period. The greatest prevalence of heat sprouting was associated with a short rest period and the smallest prevalence with a long rest period.

Heat sprouting was most prevalent in late-maturing plants. Plants that were intermediate in maturing were also intermediate in their tendency to produce heat sprouts. Only a very few tubers from the early-maturing segregates formed heat sprouts.

SEED POTATO IMPROVEMENT AND LARGE VOLUME PRODUCTION THROUGH A FOUR-YEAR-FIVE-PHASE CYCLE

Clarke W. Clemmer and Karl Koch

Eastern States Farmers' Exchange, Springfield, Mass.

Virus diseases affecting seed potatoes are controlled within practical limits by the Eastern States Farmers' Exchange in its seed potato production by a four-year-five-phase program.

I—The first phase of tnis program is the indexing of approximately 16,000 single stalk hills of the six varieties of potatoes selected from its isolated fields in Maine. Single stalk hills are chosen since all the tubers are produced by the one stalk and thus any tuber taken for indexing will be representative of the plant from which it is taken. These 16,000 single stalk hills constitute what is known as the elite seed.

To index the 16,000 hills of elite seed the potatoes from each individual hill are placed in a separate cotton bag and given a number. At

the time each bag is numbered one tuber is taken from that bag and given the same number as the bag. These numbered tubers are then shipped to Florida in groups of 25 tubers each and planted in consecutive order so that the location of every tuber is known. The plants produced by these tubers are read for disease continually from the time they are about eight inches tall until they are in full blossom. When any diseased hills are found they are recorded by number. At planting time the following spring the bagged hills, known as elite seed stored in Maine, are then sorted and the diseased hills as recorded in the Florida tests are discarded.

II—In the second phase the following spring the elite seed is increased by hand planting using the tuber-hill unit method in well isolated fields in Maine. The growing plants are carefully rogued during the growing season. The date, location and cause of removal of all rogued plants are then recorded. All rogues are placed in burlap bags to prevent the escape of aphids and are taken a safe distance to be destroyed. These potatoes are harvested early. That is, the tops are removed and the tubers dug early to prevent late season infection by viruses. The tubers produced from the 20 acres grown in this manner are called foundation seed. Before early harvesting, however, next year's elite seed is selected from these fields. The hills selected are taken from areas as far distant as possible from the rogued hills. This method reduces the chance of local current infection from the diseased units removed as rogues.

III—The third phase consists of planting this foundation seed by the tuber unit method the following year. This planting is done by seven men crews on especially designed two-row planters. Over 160 acres are planted in this manner. These fields are also well isolated and rogued carefully. The potatoes produced in this third step are called stock seed. A representative sample of each bin of stock seed is tested in Florida in order to detect current infection. Any bin with excessive virus infection is rejected.

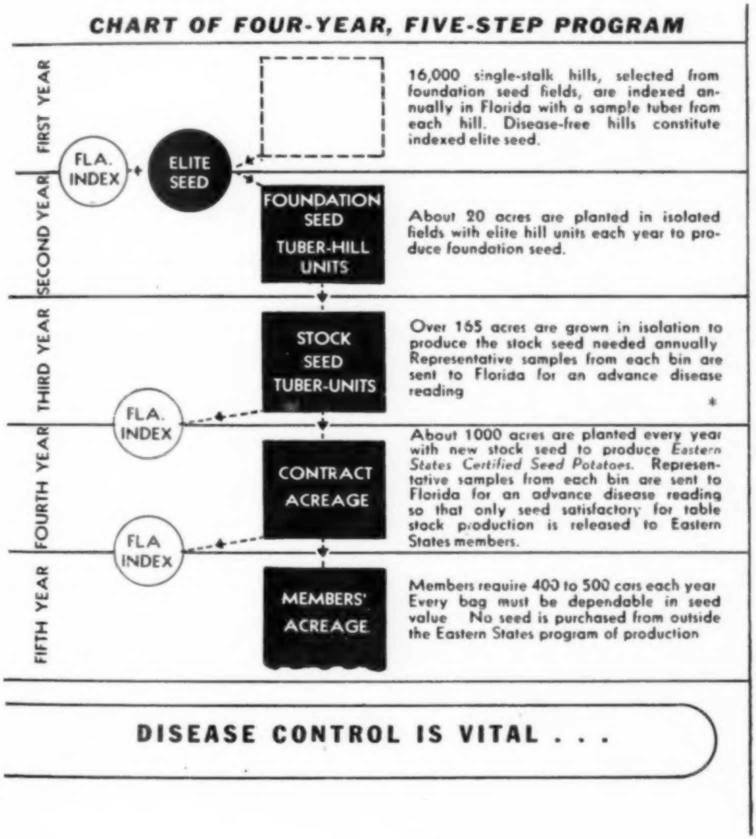
IV—In the fourth step the relatively disease-free stock seed is then used the following year for planting approximately 1,000 acres of potatoes by the normal method. The seed fields of the contract growers are carefully rogued.

There is little opportunity for disease to build up year after year on the farms of the Eastern States contract seed growers because their entire acreage is planted with new stock seed each year brought along within the four-year-five-phase cycle. A contract seed grower does not plant any seed of his own production and no seed is brought to these seed farms from outside sources except new varieties introduced by the

U. S. D. A. and state experiment stations. New introductions are subjected to the Eastern States Florida index readings and grown in isolated tuber-units before being released to the contract seed growers.

Before the 400 to 500 carloads of tubers produced in this manner are shipped to the table stock producer for seed, every bin of potatoes from the 1,000 acres is tested in Florida for current season infection. If the amount of disease in any bin of potatoes is found to be too high to make good seed for table stock production that bin is disposed of for starch or table stock even though eligible for state certification. The balance of the good seed is then shipped to the table stock producer who is, or becomes, a member of this cooperative purchasing service. This seed is grown exclusively for members of the Eastern States Farmers' Exchange. It is not available through commercial seed channels.

V—Careful checking, by field readings, on the farms where this



seed is used for table stock production has shown this program to be effective in the practical control of virus diseases. Other diseases are controlled by crop rotation, farm sanitation, exclusion of purchased stock seed, seed treatment, spraying, exclusive use of all machinery, equipment and private storage for Eastern States seed, use of new bags and freight car disinfection.

This four-year-five-phase program is in constant progression so that each phase is started anew every year.

SECTIONAL NOTES

California

Our potato markets on the Pacific Coast at present are most vitally affected by certain provisions which were not anticipated and provided for in the OPA Rules.

No provisions were made in OPA Rules covering potatoes and onions for cold storage charges, and due to this fact the ceiling prices broke sharply after the 30th of April. Potato growers, on the one hand, pushed their potatoes on the markets faster than would have occurred under normal conditions; and, on the other hand, Terminal Markets Receivers refrain from creating a reservoir by virtue of cold storing as is usually the case, with the result that until recently potato prices were considerably below ceilings.

Now, the stringency and shortage of potatoes have manifested themselves, with the result that Government facilities have been forced to take definite measures to assure themselves of the needed supplies, and the amounts remaining for use by the civilian population have shrunk alarmingly.

Regarding the final results, we cannot say at present but we believe that provisions are in order where, in the future, growers may be justified in holding a percentage of their crops for late markets and where receivers in Terminal Markets may have an opportunity to create certain reserves against the possibility of climatic upsets in the early producing sections and resultant disastrous conditions.

The cushion of reserves of old crops held by growers for late market, together with the reservoirs of cold storage supplies in Terminal Markets, have always been recognized as important safety factors and are entitled to consideration by OPA. (Feb. 6).—E. Marx.

Colorado

It is estimated that about 75 per cent of the Colorado potato crop has already moved and a few districts are cleaned up. A little over one-half of the stock is being washed. The San Luis Valley has enjoyed the most successful season in several years. Nearly 80 per cent of the shipments are U. S. No. 1 and claims are practically *nil*. The ring rot which threatened the industry three years ago is nearly cleaned up.

The 1942 crop of certified seed is nearly double the size of any previous crop and still the demand exceeds the supply. The entire state is seed-conscious and the last stronghold of poor seed has surrendered to certified seed. As the production and use of certified seed in the state has increased, so has the average yield per acre increased for the state. The production of certified seed in the state is now large enough to plant one acre out of every four planted to potatoes. It was formerly thought that one out of five was the saturation point, but it now appears that the goal should be changed to one out of three. The certified seed program still remains chiefly a state potato improvement program, although the amount of seed sold outside the state is steadily increasing.

The appearance of late blight in two counties in the state was a distinct shock, as it was commonly supposed that the climate was too dry for its existence and it had undoubtedly been introduced on infected seed stock numerous times in the past and had failed to perpetuate itself. The past two seasons have been unusually cool and wet. Every effort is being made to stamp out the disease. Infected seed is being discarded. Growers are prepared to spray with copper compounds, and a quarantine against seed from infected areas is under consideration. One season of dry warm weather would probably stamp it out, but such a season may not occur for several years, so all other precautions are being taken. (Feb. 10).—C. H. Metzger.

Florida

Growers will complete the planting of the potato crop at Hastings, Florida, by the 5th of February. Planting in this section extends over a period of approximately 7 weeks and this season we began on the 17th of December. Approximately 16,000 acres will be grown this year as compared with the 13,000 acres planted in 1942. Conditions have been very favorable for growth and plants in some of the early-planted fields now vary in size from 8 to 10 inches.

Growers of the Hastings section have switched almost entirely to growing the new varieties, Katahdin and Sebago, as 95 per cent of the

acreage has been planted to these this year, with Sebago occupying top place on 60 per cent of the potato land. Miscellaneous varieties planted on the remaining 5 per cent of the acreage are Bliss, Earlaine, Cobbler, and Sequoia. Sequoia will probably become one of the leading varieties in this section within the next few years if there is sufficient demand for it on the market. It has proved to be a better yielder than Sebago and Katahdin in test plots at the Hastings Experiment Station, and in small plantings made on several farms.

The certified seed potatoes used in planting the crop appeared to be as good as those used last year. It is, of course, impossible to determine the total amount of virus diseases in these potatoes until the plants grow and fields are inspected. In addition to 2 cars of seed in which the bags contained from 1.2 to 7.0 per cent of the tubers affected with late blight, potatoes in some cars had been damaged by freezing. It is estimated that in the 400 cars of seed shipped into Hastings this year, potatoes which had been damaged and made unfit for seed by freezing totaled at least 3 cars. This is less than 1 per cent of the shipments, but that is too much, since most of this damage could have been prevented if proper percautions had been taken by growers, shippers and transportation companies. (Feb. 9).—A. H. EDDINS.

INDIANA

There is quite a flurry among the growers and gardeners in Indiana in regard to the potato situation. I believe I have had more calls this year asking for sources of certified seed or questions on planting small plots all the way from the Victory Garden up to a quarter-acre, half-acre and even acre sizes than ever before.

Just this past week, one county that used 160 bags of certified seed potatoes last year asked for at least one car of certified seed. Other counties that used a car last year are getting two, and possibly three cars, of certified seed this year. It is the opinion of the people in this state, and we have urged them to remember it also, that if we are going to eat we are going to live at home and like it. As you know, we have been a deficiency state in the production of potatoes. With all our industries running full blast and quite a few new ones in the state, it means a still heavier drain and I presume that we could use between seven, eight or nine million more bushels of potatoes than our production.

The Irish Cobbler, Katahdin, and Chippewa are the more general types grown in this state, although there are some tendencies toward the

Sequoia and the Sebago. However, it is apparent that the Sequoia would win out as the champion of the two newer varieties. Last year in some plots here at the University, the Sequoia outyielded, by 44 per cent, the Katahdin and Chippewa. (Feb. 4).—W. B. WARD.

KENTUCKY

Kentucky is asked to increase its potato acreage to 2500 acres. Of this, Jefferson and surrounding counties "Louisville area" will take 750 acres, making a total of 5250, thereabouts. Fayette County will raise its acreage from 800 to 900.

The other commercial areas comprise the mountain counties of Laurel, Clay, Whitley, McCreary, Letcher, Knox and Jackson, where were produced, in 1942, 420 acres. As of this date, possibly 130 "new" acres will be planted, but intentions have not crystallized yet and that figure may be doubled.

There is no seed scarcity in the Louisville area or in Fayette County, since last year's crop was good. Instead of 5-10-5 or a 6-10-6 fertilizer as heretofore used, our growers will use a 4-8-8 or a 4-10-6. No fertilizer shortage is anticipated.

In the mountains, certified seed, exclusively, will be used: Maine, 30 per cent; Minnesota, 30 per cent; and the Dakotas, 40 per cent. (Feb. 9).—JOHN S. GARDNER.

LOUISIANA

Since the announced price support of $2.35 per 100 pounds incentive payments of 50 cents a bushel on normal yield for planting 90 to 110 per cent of the potato goals, farmers have become more potato-minded and increased demands have been made for certified seed and fertilizer. Some farmers who want to increase their potato production have been unable to obtain as much fertilizer as needed. The victory vegetable gardeners and some farmers have shown interest in the Katahdin variety of Irish potatoes, because of its good keeping qualities and suitability for home use. The Katahdin grown in Louisiana is very satisfactory for chips according to manufacturers in the state. Plantings from home-grown seed have made good yields for 5 to 6 years from the initial start with certified seed. Louisiana 4-H club members are working on special projects with the Katahdin this year, growing this variety for home use and local markets. (Feb. 9).—A. C. MOREAU.

MAINE

Shipments of Maine potatoes are running about 3500 cars ahead of last season at the middle of February. The demand is exceptional and if it were not for refrigerator car shortage, shipments would proceed at an even faster pace. This can be accounted for in four ways: (1) We have produced one of the best quality crops in years; (2) have increased consumption and Army demands; (3) the location of available supplies in the late potato-producing territories results in further emphasizing the widespread call for Maines, and (4) prices having reached ceilings, growers are inclined to move stock freely without the usual brake that wishful thinking of further price advances in the late spring normally gives.

Shipments of seed potatoes thus far have not quite kept pace with shipments of a year ago at the same time, despite the larger acreage, and it appears now that there may be serious complications ahead for seed growers in getting out shipments in time to the trade. Probably we have never had such a widespread call for Maine seed as this year, and the next eight weeks will be busy times for seed growers.

Price ceilings were reached in January, and we found ceiling schedules out of adjustment between the differently sized packages. They first reached ceiling prices on 10-pound bags, then 15's, and next the 50-pound, and finally the 100-pound units. There are some possibilities of adjustment of ceiling prices so that the relationship will be better balanced between the differently sized packages. Lack of labor is a factor that influences the size of packages being used at present. It seems difficult for the average shipper to get labor sufficient to load the smaller units. In view of the heavier than normal daily shipments, it is paradoxical that we find ourselves facing a car shortage, but such is the case, the demand for cars being greater than the supply because of the factors mentioned above.

Prospective acreage expansions are hard to forecast accurately at present, but is seems probable that there will be substantial increases in acreage this year. Everywhere our growers feel that this is one definite contribution they can make to the war effort, and this, despite all the difficulties confronting us now.

The natural inclination of every one is to reduce, but the need is so urgent for potatoes that promises of assistance for supplies and labor are encouraging and every one is determined to do his utmost by increasing his acreage.

Florida tests conducted by the Experiment Station and the State

Department of Agriculture are again proving their great worth, and we find much activity in purchasing the seed that showed up well in the winter test. The Florida tests this year emphasized anew the need for vigorous unrelenting war upon our aphis population. The research people are bending every effort to assist growers to meet this problem successfully. As yet there is much to be learned. Substantial progress is being made, however, and efforts of those growers who are growing seed plots in isolation under carefully controlled conditions bear eloquent testimony to the value of such work. More needs to be done by public agencies cooperating with private efforts to insure the retaining at home of our best seed stocks.

Greater efforts are being made to eliminate dump piles. They are proving the source of much of our blight infection. Greater efforts, too, are being exerted in stamping out ring-rot. We have the information on how to do it and where to do it, but growers are not doing everything that should be done to eliminate ring-rot among table stock growers.

Even better than expected demand is coming for the new Super Spud grade sponsored by the State Department of Agriculture and reinforced by our advertising program. We are not forgetting about the home folks either, as these quality packages are being made available throughout the state of Maine. Prospects of increased shipments of these quality packages are decidedly bright. (Feb. 11).—FRANK W. HUSSEY.

MICHIGAN

It would seem somewhat early to make any prediction regarding the planting in Michigan for the coming season. However, judging from sales of Certified Seed and the interest in a better potato program; growers are either interested in an increase in acreage or the maximum production on their normal plantings.

Michigan potato acreage has declined during the past five years. It will be interesting in watching developments between now and planting time to see if the state-increased goal can be obtained. Growers are much concerned on labor situations, not only from the standpoint of harvesting but for lack of key men that are trained in the production and preparation of the crop for market. (Feb. 10).—H. A. RILEY.

MINNESOTA

There has been a feeling of uncertainty among many potato grow-

ers concerning what steps to take in 1943. Last fall considerable difficulty was experienced in harvesting the crop and many producers felt that if they had to cope with these difficulties this year that it probably would be wise to reduce their potato acreage drastically. In fact, some had just about decided not to plant any potatoes in 1943. Price ceilings established for the large commercial areas, although not deemed entirely satisfactory, have somewhat helped the situation.

The 1942 crop report reveals that we had 215,000 acres of potatoes in the state from which was harvested 204,000 acres with a production of about 20 million bushels. Late Blight and a severe early freeze in August somewhat reduced the yield. The quota for Minnesota for 1943 is 256,000 acres. If there is to be an uncertain labor situation, if potato machinery can not be replaced or repair parts secured, if spray materials, both fungicides and insecticides are not going to be readily available, it is quite conceivable that the quota requested can not be planted. No grower is going to plant a crop which requires the care and labor necessary for a good crop of potatoes, unless he is assured that he is going to be able to harvest it.

During the past five or six weeks the certified seed business has been unusually good. Up to the 1st of February, certification tags had been issued for 958 cars of certified seed potatoes and there seems to be a strong demand for such stock. Evidently growers in the seed potato-consuming territories are satisfied that they will have sufficient help and that the ceiling prices to be established for them will be satisfactory. (Feb. 3).—A. G. Tolaas.

MISSISSIPPI

The prospective 1943 commercial potato acreage in Mississippi as estimated by the Bureau of Agricultural Economics, is 2800 acres, as compared with 3000 acres in 1942. The recent government plan for making incentive payments to commercial potato producers for increasing acreage to meet war needs may tend to increase the total acreage to be planted in 1943. However, farm labor shortage will have a depressing effect on the acreage that can be produced. There is a serious shortage of labor in the principal commercial producing areas of the state caused by the movement of labor from farms to industry and to the armed forces.

Producers are dependent upon northern grown seed supplies, as potatoes produced in the state are never so satisfactory as northern-grown supplies. Seed supplies will be ample for all needs including any

increased acreage planted as a result of incentive payments offered by the government.

Although certain types of fertilizer materials will be limited, it is expected that ample supplies will be available for the production of all essential war crops, including potatoes. Planting is beginning to get under way in the southern part of Mississippi, and practically all our commercial acreage will be planted during the month of February. (Feb. 6.)—J. V. PACE.

NEBRASKA

The Nebraska growers have come through a very erratic season. 1942 was one of the most unusual (with apologies to California and Florida) seasons in several years. The rainfall in the spring and summer was the heaviest in about ten years. At time of planting, conditions were excellent, and the fields progressed very rapidly during the summer. During August, a brief dry and hot spell occurred, which slowed up dry land fields. Irrigated fields progressed rapidly, and Early Blight set in early.

On the 8th of September, there was a light frost. On the 25th, the temperature dropped to 18°, with the result that freezing injury was found throughout the territory, varying from 5 to 25 per cent. Fields that were properly handled, escaped most of the damage, but an occasional field suffered so badly that harvesting was abandoned. Discouragement on the part of the potato growers was general after harvest. Labor difficulties had plagued them throughout the year,—with help going to local defense plants, excessively high wages were also demanded, and the severe weather conditions "topped" it all. Many growers planned on severely reducing, or discontinuing production.

During the winter shipping season, with the trouble due to frost behind them, and with definite encouragement on the part of the Government for improved labor, and better prices, our picture is improving. Without a doubt there will still be a reduction in acreage in 1942, but not as severe as originally intended. The '42 crop was 20 per cent less than '41, and the reduction during '43 over the past year will be less.

The price for Certified seed potatoes showed a good premium over table stock throughout the winter, and is encouraging more growers to plant, as well as encouraging some of the old growers to increase their acreage. Before the first of March, all of the Certified seed crop will be cleaned up, both for export and for local demand. There has been a very active demand during January for all seed, both certified and

non-certified. The inevitable gambling instinct on the part of farmers is again asserting itself. (Feb. 10).—MARX KOEHNKE.

NEW YORK

About 2,550 acres of seed potatoes were eligible for certification in New York this year, 33 per cent being the Green Mountain variety, and about 30 per cent the Katahdin. Acreages of Sebago, Houma, and Chippewa were larger than usual but still not enough larger to satisfy the demand. A small volume of Pontiac, Earlaine 2, and Warba were also certified. Sebago is on the increase in New York, especially among the growers who formerly grew Rural, and where blight rot was severe in 1942. The prospects for an increased planting of Sequoia, Earlaine 2, and Pontiac in 1943 are good. Mohawk, introduced last year, will be tried by as many growers as can get seed. This variety seems best adapted to the lighter soils in regions where Green Mountain and Houma are known to do well, as in Northern New York and on Long Island. The production in 1943 will consist mainly of foundation stock. As of January 1, less certified seed remained in the growers' hands than normal.

The annual convention of the Empire State Potato Club, held at Syracuse on the 6th and 7th of January, was a distinct success. Growers are keenly interested in the problem of maintaining production in 1943. Labor, spray machinery, and fertilizer appear to be real bottlenecks. To meet the New York goal of 30 per cent increase in acreage, growers much increase the 1942 acreage by more than 50,000 acres. Over 90 per cent of our growers normally plant 4 acres or less. Naturally these are ill equipped to do a thorough job of spraying. Too little potato machinery is in sight at this time to encourage any increase in planting. Less than 10 per cent of our growers normally plant more than 50 per cent of the total acreage and produce over two-thirds of the total crop. These large growers feel that present restrictions on fertilizer will prevent any further increase in yield per acre. Production could be increased by an increase in acreage planted if, and to the extent that, the necessary supply of labor and machinery could be provided. The recently announced "floor price" schedule for the 1943 crop may help some but the so-called incentive payment of 50 cents a bushel on the crop from the increased acreage representing 90 to 110 per cent of the goal does not appear attractive. It is distinctly distasteful to some growers who realize that it can mean an increase of only 5 to 10 cents a bushel on the entire crop, and that it is essentially a consumer subsidy. (Feb. 8).—E. V. HARDENBURG.

NORTH CAROLINA

Growers of commercial early Irish potatoes in the eastern counties of North Carolina intend to plant five per cent less acreage in 1943 than was harvested in 1942. According to the Federal-State crop reporting service, this represents a decrease of nine per cent as compared with the ten-year average, 1932-'41. Based upon reports received from individual growers in the early belt, approximately 30,400 acres will be planted in 1943 as compared with 32,000 acres for 1942 and a ten-year average of 33,540. A decrease was indicated by all counties in the east except Camden and Pasquotank where slight increases were reported. (Report based on information received the middle of January.)

The North Carolina Crop Improvement Association has certified 15,305 bushels of Sequoia, 200 bushels of Green Mountain and 150 bushels of Irish Cobbler from the 1942 crop.

Mimeographed sheets have been prepared giving yield records of fourteen varieties and eight selections in Eastern North Carolina. Varities and selections are ranked according to total yield, and the yield of U. S. No. 1 potatoes for the years 1940, 1941 and 1942. In total production Red Warba and Pontiac have outyielded Cobbler. In 1942 Pontiac led all other varieties in the production of U. S. No. 1 potatoes at two locations. Although this information has been prepared primarily for Irish potato growers in Eastern North Carolina, a copy of the report will be sent, upon request, to others who may be interested.

The fertilizer situation has cleared somewhat and at present does not appear to be so serious as anticipated at first. (Feb. 8).—M. E. GARDNER.

OHIO

Russet Rural is still the standard late variety in Ohio, but it encounters strong market prejudice because of the internal blackening when cooked. Katahdin has partially replaced the Rural, especially on commercial acreage, but the tubers of Katahdin form so close to the surface that in regions like Ohio, where potatoes are not hilled, too many of them become greened. Sebago seems to be more promising. Growers say that it yields about the same as Rural, and speak very highly of its cooking quality.

Seedling 47,101 first distributed for trial six years ago, by the breeders of the U. S. Department of Agriculture, has been an outstanding late potato in tests at Wooster. On the average, it has out-

yielded Russet Rural. The eyes are somewhat deep but in all other respects it has surpassed Rural. Since the tests to date indicate that it may be the most valuable late potato for Ohio, it has been named Erie. Several Ohio growers have been attempting to grow some seed of Erie, but their stocks can hardly be recommended as foundation for certified seed. A small amount was certified in Michigan but the quantity will need to be considerably increased before it will be available to seed growers in other states. (Feb. 3).—JOHN BUSHNELL.

PENNSYLVANIA

Certified seed potatoes have stored quite well. With all the blight that we had in Pennsylvania during the 1942 growing season, we naturally expected a considerable amount of breakdown, but this has not occurred. Although some blight-rot is showing, it is dry, and very little difficulty is being experienced by our growers in their grading operation.

Where the seed was placed in storage during the early part of the digging season and when the weather was still hot, more breakdown is being found than in cases where the potatoes were dug and stored during cooler weather.

The certified seed crop is uniform and of an economical planting size. There were fewer large or oversized potatoes in the 1942 crop than in many of our previous crops. Some of our Sebagoes are somewhat over size, but they are smooth and quite uniform.

The demand for certified seed is heavier this year than usual. This demand is the result of the request of the Federal Government for an increase in the 1943 potato acreage compared with the 1942 planting. Our seed growers have already sold the earlier varieties and have only a limited amount of the late varieties.

Potatoes that are near-certified or one year removed from certification are being diverted into seed channels. Even with this additional supply of seed available, it is going to be very difficult to supply the demand for seed for the increased acreage.

Since most of our Pennsylvania certified seed potatoes are being grown in the mountain counties or what we call the center of the "deer country," it might be of interest to know that we really do have a few deer in this State. On a potato inspection trip during this week of sixty miles covered in one day, I counted 39 deer. The following day by noon I counted 56 and during the afternoon, 121, and all on a 54-mile trip. In two days I counted 216 deer while traveling 114 miles

and all on different roads. At this time of the year the deer come out of the forests to feed on the sunny hillsides where the snow has melted. (Feb. 10)—K. W. LAUER.

SOUTH DAKOTA

South Dakota potato growers are now busily engaged in shipping certified seed potatoes for the southern trade. The Bliss Triumphs are about cleaned up and Irish Cobbler shipments are starting. The growers had a good year last season, despite late blight which destroyed the vines on some fields prematurely. The blight was checked by warm weather and no tuber damage resulted.

All prospects are good for a 25 per cent increase in the certified acreage in 1943. This would increase the acreage more than 3,000.

The labor situation may lower the acreage of commercial stock, although the incentive on bonus payment proposed may help to increase the acreage.

The annual meeting of the South Dakota Potato Growers Association will be held on the 27th of February. (E. A. Fletcher, of Garden City, is president of the Association). (Feb. 9).—JOHN NOONAN.

TENNESSEE

The Cumberland Plateau, an area of 5000 square miles extending centrally across the state from north to south and having an elevation varying from 1400 to 2000 feet is in line for development as an area of high quality potato production. The region is now approximately 92 per cent second growth wild range land. About 30 per cent of the Plateau land is suitable for cultivation, based on slope and depth. The extreme phosphate soil deficiency has hindered its development, but the present availability of cheap phosphates is rapidly altering the situation. The evacuation of the TVA reservoir areas is also having the effect of increasing the farm population very rapidly in this area of cheap, undeveloped land.

The high cooking quality of the Plateau potato is recognized throughout the state. Something over 3,000,000 bushels are now produced in Tennessee annually, largely under unfavorable conditions, while the state consumes over 11,000,000 bushels. The generally poor quality of potatoes grown under unfavorable conditions in many parts of the southern region has no doubt had the effect of limiting the *per capita* consumption of white potatoes in the south. It is believed that

an increase in potato production on the favorably situated Cumberland Plateau would materially improve the status of the white potato, at least in Tennessee.

Of the state's 42,190 acres in potatoes, 5,500 acres are now being grown on the Plateau. A decided increase in acreage throughout the state is expected in 1943. Labor shortage will not tend to reduce harvested acreage since the major portion of the crop is produced by family labor on small acreage in this state. (Feb. 11).—J. J. Bird.

TEXAS

Rain during the early part of January, and freezing weather during the period from the 19th to the 28th, delayed the planting of a portion of the spring crop, but conditions have been highly favorable since that period.

In the fall (October) planted tests, Sebago, Katahdin, Sequoia and Pontiac were outstandingly better than the commonly grown Bliss Triumph variety, from the standpoint of yielding ability, resistance to scab and keeping quality. These "new" varieties also produced excellent yields during the early spring season of 1942. There is increasing grower interest in reliable seed stocks of these high yielding, disease-resistant varieties.

Shortage of labor to harvest the spring crop is likely to be the biggest problem facing potato growers in this region. (Feb. 8).—W. H. Friend.

VIRGINIA

The Virginia potato goal has been increased to 83,000 acres which is 11,000 acres more than were grown in 1942. Of this increase approximately 10,000 acres have been allotted to Northampton and Accomack, the two Eastern Shore counties. Since these counties have also been given increased goals for soybeans, tomatoes and other vegetable crops, it may not be possible to obtain the allotted goal for the spring crop. The acreage which can be grown will, of course, be determined, to a large extent, by the labor which may be available during the harvest period, but in some cases growers will not have sufficient labor available to plant and cultivate their normal allotment of potatoes. However, it is to be expected that if we have normal weather conditions and do not increase our acreage above that of 1942, the production from eastern Virginia this year will far exceed that of 1942 when our

yield per acre was about 60 per cent of our normal production. In addition, it is expected that should we fail to meet our allotment quota for the spring crop, we will still have another opportunity to make up this deficiency in the fall. It is expected that quite a large acreage of Sebagoes will be planted in northern Accomack county and also in Princess Anne and Norfolk counties in late July for our harvest during October and November. The Sebago variety has given very good results when planted as a fall crop during the past three years. It has been interesting to note that the Sebago is entirely unsuited to spring production in this area, because it "sets" a comparatively small number of tubers during the long day period in June and July when compared with the "set" during the relatively short day period in September and October.

A 5-10-5 fertilizer will be used this year instead of the customary 6-8-6. Some of the growers are worried lest the potato crop will suffer from a shortage of nitrogen if we have an abnormally wet season. Our recommendations have been not to plant potatoes on land which is very low in organic matter because we believe that the reduced amount of nitrogen may not produce a fair crop of potatoes on the poorer soils even under normal weather conditions. It was found in experiments conducted on a total of 137 farms in 1940 and 1941 that soils carrying less than 1½ per cent organic matter are undesirable for potato production. (Feb. 8).—H. H. ZIMMERLEY.

VERMONT

A 30 per cent increase in Vermont potato acreage has been requested by the State Farm War Board. Shortages of man power and machinery are the limiting factors, but growers appear to be going ahead to reach the goal as nearly as possible. The requested increase would amount to approximately 3,500 acres.

The 1942 certified seed list showed a total of only 325 acres, approximately the same as for 1941. There was, however, a very noticeable trend away from Green Mountains and toward Katahdins and Houmas. Continued difficulties with net necrosis in Green Mountains is the main cause for this change, though both the newer varieties are proving very satisfactory potatoes in their own right. Only a few Sebagoes have been tried in Vermont.

The Vermont Maple Cooperative, Inc., of Essex Junction, with potatoes as one of its sidelines is handling a considerable volume of native stock through the chain store systems. They are largely using peck packs, with a few 50 lb. bags. The "Co-op." acts simply as a

selling agent. Contracts are made by it to supply chain stores, and orders are placed with its grower members to pack and deliver the potatoes directly to the stores. Top Boston wholesale price is the basis on which transactions are made and a commission of 5 cents per bushel is retained by the Cooperative. About 75,000 bushels are handled every year in this manner. (Feb. 10).—HAROLD L. BAILEY.

CANADA

The production of certified seed potatoes, graded stock, in 1942, totalled three and a half million bushels—a reduction from 1941 of approximately 17 per cent. The principal varieties were Green Mountain, 1,250,000 bushels; Irish Cobbler and Katahdin, 875,000 bushels each; and Bliss, 268,000 bushels.

Shipments to trans-oceanic markets were much lower than usual, because of the lack of shipping space, but other markets have been active, and approximately 1,000,000 bushels of certified seed potatoes were shipped by the 31st of January, 1942. Substantial orders have been booked for shipment in April, and the indications are that the spring markets will be very active. Some shippers are already finding it impossible to offer quotations for spring shipments of some varieties. (Feb. 11).—W. N. KEENAN.

AMONG OUR ADVERTISERS

For a number of years the American Potash Institute has been interested in a method of application as related to efficiency in fertilizer use and has cooperated in experimental and demonstrational work with experiment stations and potato growers. An article bearing on various phases of this work appeared in the November 1942 issue of "Better Crops with Plant Food." Of particular interest in this article are reports on the progressive studies of potatoes. The development of potato-planter distributors which place the fertilizer two inches each side of and on a level with the seed piece, instead of in contact with the seed piece in the row, has revolutionized potato farming. Fertilizer injury has been almost entirely eliminated and efficiency in its use greatly increased.

More recent experiments involving the plowing under of two-thirds to three-fourths of the total fertilizer application, with the balance in

bands to the side of the row, show that yields may be significantly increased by employing this practice. An average increase of slightly more than 55 bushels per acre above the all-in-band method was secured in 1942 field tests.

Reprints of the article entitled "Some Experiences in Applying Fertilizer" as well as a number of valuable reprints of articles from "Better Crops with Plant Food," are available upon request,—and free of charge to farmers, official agricultural workers, and the fertilizer industry.

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YIELD LOSSES CAUSED BY LEAF ROLL OF POTATOES

H. C. Kirkpatrick and F. M. Blodgett[1]

Cornell University, College of Agriculture, Ithaca, N. Y.

A method for the determination of the losses in yield caused by diseased or missing plants was described by Blodgett (1941) and applied by Tuthill and Decker (1941) to two varieties of potatoes grown on peat soil near Elba, New York in 1940. In 1941, one additional leaf roll test was made. During 1942, further application of this method was made with three potato varieties, Chippewa, Cobbler and Green Mountain in Madison, Cortland, Genesee and Tompkins counties of New York. A total of eight lots of data has been obtained for the losses due to leaf roll. The purpose of this paper is to summarize these results.

METHODS

During July and August, potato fields with good stands and few diseases other than leaf roll were inspected, and those showing approximately 50 per cent leaf roll were used for the tests. These fields were: one of Cobblers on the Elba muck in Orleans County showing 40 per cent leaf roll; one of Green Mountains in Cortland County with 42 per cent leaf roll; one of upland-grown Chippewas in Madison County with 50 per cent leaf roll; and one of Cobblers in Tompkins County that had been indexed to show 50 per cent leaf roll and 50 per cent virus-free seed, at planting time.

[1]The following research assistants participated in collecting the data presented in this paper.—C. S. Tuthill, Dr. P. Decker, R. E. Wilkinson, C. A. Thomas and W. F. Mai.

The leaf roll plants were staked about blossoming time. With the exception of one case a second inspection was made in an attempt to eliminate any errors.

The potatoes were harvested by hand as soon as the vines were dead and the weights of the central hills of each class were recorded. The classes used were: (1) healthy with a healthy plant on each side (HHH), (2) healthy with a leaf roll plant on one side and a healthy on the other (HHD), (3) healthy with leaf roll plants on both sides (DHD), (4) leaf roll with healthy plants on both sides (HDH), (5) leaf roll with a healthy plant on one side and a leaf roll on the other (DDH), and (6) leaf roll with leaf roll plants on both sides (DDD). Nearly all the plants in the field could be placed in one or another of these classes. Where skips or mosaic-infected plants were indicated, the hills on either side were not considered in any of the leaf roll classes.

Results

TABLE 1. *Average yield per hill in pounds of the center hill of the various classes of healthy and leaf roll potatoes.*

Variety	HHH⁺	DHH⁺ HHD	DHD⁺	HDH⁺	DDH⁺ HDD	DDD⁺	Total No. Hills
1940							
Chippewa	2.059	2.186	2.408	1.221	1.257	1.222	551
Cobblers	1.537	1.698	1.891	.654	.782	.722	1210
1941							
Chippewa	1.869	1.931	1.826	1.196	1.225	1.267	810
1942							
Green Mts.	1.754	1.932	2.240	.907	.860	1.064	301
Cobblers	.967	1.073	1.181	.579	.613	.648	638
Chippewa	1.382	1.566	1.700	.478	.624	.664	295
Cobblers*	.913	.912	1.024	.515	.587	.547	239
Cobblers#	.860	.929	.979	.573	.436	.486	177
Averages	1.418	1.530	1.656	.766	.798	.828	
Average in relation to HHH class	1.000	1.079	1.168	.540	.563	.584	
Average in relation to HDH class				1.000	1.042	1.081	

*2000 lbs. of fertilizer to the acre.
#1000 lbs. of fertilizer to the acre.
⁺H indicates a healthy plant and D a leaf roll plant.

From the yields of these various classes (table 1) it may be seen that, although there was considerable variability in individual cases, hills having leaf roll plants on one or both sides have, in most cases, yielded more than comparable hills adjoined by healthy plants. Also, the gain in yield for plants having leaf roll plants on both sides has averaged about twice as much as plants with leaf roll plants on one side only. Thus healthy plants with leaf roll on both sides averaged 16.8 per cent higher yield than did the healthy plants surrounded by healthy plants. Healthy plants with leaf roll on one side only, gained 7.9 per cent in yield. The average gains in yield for leaf roll plants competing with leaf roll plants on one side (4.2 per cent) or both sides (8.1 per cent) compared with those having healthy plants on each side was only about one-half as great as it was for healthy plants.

Blodgett (1941) gives a formula and a table for estimating the number of plants in the several classes in a random distribution for various percentages of disease. If the frequency of each class is multiplied by its relative yield and these products summed, the relative yield for any given percentage of disease may be obtained. Using the relative figures from the above table (yield of healthy equals one), the formula, with the class of each term written above, becomes

$$Y = \overset{\text{DDD}}{.584\,p^3} + \overset{\substack{\text{DDH}\\ \text{HDD}}}{.563(2)p^2q} + \overset{\text{HDH}}{.540pq^2} + \overset{\text{DHD}}{1.168p^2q} + \overset{\substack{\text{DHH}\\ \text{HHD}}}{1.079(2)pq^2} + \overset{\text{HHH}}{q^3}$$

In this formula p is the fractional or decimal part diseased, q the part healthy, and Y the relative yield compared with healthy plants. Using the formula above or the table referred to (1) for the value of the several terms, the relative yields have been computed for potatoes with certain percentages of leaf roll (table 2). The average yields per hill and per acre in these fields and the percentage loss in yield for these percentages of leaf roll have been estimated and are also shown in table 2.

In the paper by Blodgett (1941), it was pointed out that if the influence of diseased or missing plants on both sides of another plant is twice as great as the influence of a diseased or missing plant on one side only, then the equation above could be simplified to the equation of a parabola. This condition is closely approximated in the average figures given above and the following is therefore suggested as an approximation of the equation previously given.

$$Y_D = (1 - .295p - .121p^2)\ Y_H$$

In this equation YH equals the yield of healthy stock and if one wished to use it to estimate the yield of healthy stock from the yield of

TABLE 2. *Estimated yields for various percentages of leaf roll based on the average yields of the six classes.*

Percentage of Leaf Roll	Relative Yield in Percentage of Yield of Healthy	Estimated Yield		Percentage Loss Due to Leaf Roll
		Pounds per Hill	Bushels per Acre	
0	100	1.42	393.0	0
10	96.9	1.37	380.7	3.1
20	93.5	1.33	367.6	6.5
30	90.0	1.28	353.7	10.0
40	86.2	1.22	338.8	13.8
50	82.2	1.17	323.1	17.8
60	78.0	1.11	306.4	22.0
70	73.5	1.04	288.7	26.5
80	68.7	.97	270.0	31.3
90	63.7	.90	250.3	36.3
100	58.4	.83	229.5	41.6

leaf roll stock (YD) in which the decimal part (p) affected with leaf roll is known; the equation might be written in the following form:

$$Y_H = \frac{Y_D}{1 - .295p - .121p^2}$$

SUMMARY

The data presented confirm the opinion that the healthy hills adjoined by leaf roll plants on one or on both sides, compensate, in part, for the low yield of the leaf roll plants.

The gain in yield of a healthy plant adjoined on both sides by leaf roll plants is approximately double the gain of such plants adjoined by a leaf roll plant on one side only.

The tables presented show the average yields of the plants in the different classes in these fields and also the relative yields of potatoes with various percentages of leaf roll in them. The same results are also expressed in the form of equations which can be used to estimate the yielding capacity of a variety, strain or plot, even though, when grown, it has in it a known percentage of leaf roll.

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THE INFLUENCE OF SOIL EROSION ON FERTILITY LOSSES AND ON POTATO YIELD[1]

O. R. NEAL[2]

Agricultural Experiment Station, Rutgers University, New Brunswick, N. J.

The maintenance of productivity of agricultural lands is recognized as vital to our present and future war effort. Requirements for the production of most of our staple crops are higher than ever before. It is requested that the all-time high production of 1942 be still further increased during the 1943 crop year. This must be accomplished with a limited supply of fertilizing materials, since certain fertilizer constituents are required for other purposes. The importance of good soil management practices and general efficiency of production has never been greater.

The lowering of fertility and productivity of farm land results from the combined action of many factors. Some of the more important of these are the removal of fertility constituents by growing plants, the loss of soluble material by leaching, and the reduction of organic-matter content through microbiological activity. In addition to these and other factors, recent research findings have shown that the process of soil erosion is one of the most serious forces in the rapid depletion of fertility and productivity on cultivated lands.

In studying the effect of erosion on soil productivity, particular attention has been given to organic-matter losses. Such a procedure resulted from the general recognition of the importance of organic matter in the maintenance of soil productivity and the conservation of the soil itself. This point has been demonstrated many times in the cultivation of virgin soils. When lands were first cleared or broken from native sod, run-off and erosion losses, during the early years of cultivation, were comparatively small regardless of the practices followed and to a considerable extent, regardless of the steepness of slope. The effects of the relatively large content of decomposing organic matter on physical properties of the soil, and on the ability of the soil to take up water, were such that most of the rainfall was absorbed at the point of fall and little run-off occurred. This condition

[1]Joint contribution from the Soil Conservation Service, Office of Research, U. S. Department of Agriculture, and the New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, N. J.

[2]Project Supervisor, Research, Soil Conservation Service, New Brunswick, N. J.

served not only to keep erosion losses at a low figure, but the increased amount of moisture in the soil enabled growing crops to withstand short periods of drought without serious damage. It has been pointed out that rainfall during recent droughts was no less than has occurred during earlier periods without serious drought when our soils had been under cultivation for a much shorter time. It appears that the cause is not so much reduced rainfall as it is a decrease in the ability of the soils to absorb and hold moisture. This, in turn, appears to be directly related to a reduction in organic-matter content of the soils.

Information concerning losses of organic matter through erosion have been reported by Slater and Carleton (2,3). Data on the magnitude of the losses of organic matter and fertility constituents through erosion have been obtained at the Soil Conservation Experiment Station located near Marlboro, in Monmouth ounty, New Jersey In addition to the measurement of total amounts of soil and water lost under different crops and soil treatments, representative samples of the eroded material have been collected for laboratory analysis. The amounts of organic matter, nitrogen, phosphorus, potassium, and calcium in this material have been determined. By combining these results with total soil losses, it is possible to determine the total amount of loss of any of the above constituents for any particular time, or for any soil and crop treatment represented. Results obtained during earlier years of this investigation have been reported by Knoblauch, *et al* (1).

The concentration of organic matter in eroded material for the four-year period of operation is shown in table 1. Also shown are the

TABLE 1.—*Organic matter in the plowed layer and in eroded material from Collington sandy loam*

Treatment	Organic Matter in		Factor
	Plowed Layer Per cent	Eroded Material Per cent	
Check	1.00	4.04	4.04
Cover crop	1.11	4.67	4.21
Manure	1.26	5.27	4.18
Manure and cover crop	1.31	5.15	3.93

organic contents of the variously treated areas at the end of the period of treatment and factors indicating the relation between the plowed layer and the eroded material with respect to organic-matter content.

The selective nature of the erosion process on these soils is emphasized by these results. The organic content of the eroded material is approximately four times that of the soil from which the erosion occurred. This apparently results from the fact that water flowing over the surface of the soil removes certain fractions high in organic content, rather than removing a layer of the soil as a unit.

The values in table 2 show total soil losses, losses of organic matter in pounds per acre, and equivalent soil losses. The latter values are calculated by multiplying total soil losses by the factors shown in table 1, and represent the amount of field soil required to contain the quantity of organic matter lost. These data also emphasize the effectiveness of the treatments listed in reducing erosion losses.

TABLE 2.—*Soil and organic matter losses by erosion with calculated equivalent soil loss in terms of organic matter from June 12, 1938, to Dec. 31, 1941*

Treatment	Soil Loss	Organic Matter Loss	Equivalent Soil Loss
	Pounds per Acre		
Check	39,620	1600	160,000
Cover crop	22,840	1067	96,000
Manure	24,640	1299	103,000
Manure and cover crop	16,080	828	63,000

Losses of nitrogen, although not shown separately, have paralleled the organic-matter losses very closely. In general, the nitrogen content of the eroded material has averaged approximately four times that of the soil. The average yearly loss of nitrogen through erosion from the check plot, for example, is equivalent in amount to that contained in 180 pounds of nitrate of soda.

Losses of phosphorus as a result of erosion are shown in table 3, together with the amount of phosphorus in the field soil and in the eroded material. The increased concentration in eroded material as compared with the soil is much less than is the case with organic matter. Nevertheless, losses of phosphorus through the erosion process occur at a rate one and one-half times greater than that for losses of the entire soil as indicated by total weight. The average yearly loss of phosphorus

from the check plot is equivalent in amount to that contained in 335 pounds of 20 per cent superphosphate.

TABLE 3.—*Erosion losses of phosphorus from Collington sandy loam from June 12, 1938, to December 31, 1941*

Treatment	Total P_2O_5 Loss Lbs/Acre	P_2O_5 in Plowed Layer Per cent	P_2O_5 in Eroded Material Per cent	Factor
Check	234.6	0.372	0.592	1.59
Cover crop	132.7	.372	.581	1.56
Manure	134.8	.372	.547	1.47
Manure and cover crop	88.0	.372	.547	1.47

Potassium losses as a result of erosion are shown in table 4. The

TABLE 4.—*Erosion losses of potassium from Collington sandy loam from June 12, 1938, to December 31, 1941*

Treatment	Total K_2O Loss Lbs/Acre	K_2O in Plowed Layer Per cent	K_2O in Eroded Material Per cent	Factor
Check	784.4	1.36	1.98	1.46
Cover crop	434.0	1.36	1.90	1.40
Manure	465.7	1.36	1.89	1.39
Manure and cover crop	260.5	1.36	1.62	1.19

potassium content of eroded materials has averaged approximately 1.4 times that of the soil. The relatively large amounts of K_2O lost, result from the fact that the soil supply of total potassium is considerably higher than that of phosphorus and calcium.

The extent of calcium losses in eroded material is shown in table 5. The average content of calcium in material removed by erosion has averaged 2.3 times that of the soil.

It is evident from the above data that erosion removes not only a part of the soil but, due to the selective nature of the process, may also decrease the quantity of organic matter and plant nutrients in the soil that remains. The organic-matter losses are particularly large. This is of considerable importance since organic-matter maintenance, even

on non-erosive areas, is a difficult problem on the intensively-cultivated Coastal Plain soils. The results in table 2 show the effectiveness of organic-matter additions in controlling erosion. The influence of good quality organic material on soil and water conservation is of no greater

TABLE 5.—*Erosion losses of calcium from Collington sandy loam from June 12, 1938, to December 31, 1941*

Treatment	Total CaO Loss Lbs/Acre	CaO in Plowed Layer Per cent	CaO in Eroded Material Per cent	Factor
Check	215.1	0.263	0.543	2.06
Cover crop	150.1	.263	.657	2.50
Manure	152.0	.263	.617	2.35
Manure and cover crop	101.8	.263	.633	2.41

importance than its effect on fertility level and soil productivity. The decomposition of organic material liberates nitrogen and other elements necessary for plant growth. There is some tendency for the liberation of these nutrients as they are required by the growing crops, since environmental conditions which promote rapid plant growth also tend to stimulate the activity of soil micro-organisms which are responsible for the decomposition of the organic material. In addition, as pointed out above, the improved moisture conditions resulting from the presence of organic matter in the soil tend to improve plant growth and increase crop yields.

In addition to the experimental evidence (discussed above) to the effect that erosion reduces the supply of plant nutrients, numerous field observations have indicated that crop growth and yield are reduced on eroded areas. Within any particular field, the crop yield is often much less on eroded spots than on uneroded parts of the same field.

In order to study the problem directly, studies have been in progress during the past two growing seasons on land in central New Jersey. An attempt has been made to determine the influence of the depth of surface soil on potato yields. The depth of surface soil remaining in place is taken as an indication of the extent to which erosion has occurred. Since it is very difficult to determine surface soil depth exactly, particularly where the depth is less than that turned by plowing, areas where yields were taken were divided into classes having 0-3 inches, 3-6 inches, 6-9 inches, and more than 9 inches of surface soil. In

some cases only the first two classes and an additional class designated as more than 6 inches were studied. In each case, the area on which yield was measured consisted of two adjacent rows 50 feet in length. Differences in yield, as an indication of the influence of depth of surface soil, were always determined separately for each field. In a study of this kind, it is essential that yield comparisons be made within fields rather than between different fields or farms. For example, a valid comparison cannot be made between the yield from a 0-3 inch soil depth on one farm and that from a 3-6 inch soil depth on another farm, since differences in either previous treatment or in present cultural and fertilization practices might completely mask the effect of soil condition or degree of erosion on crop yield.

The data in table 6 show the average yields over a two-year period

TABLE 6.—*The influence of depth of surface soil on potato yields. Two-year average from one New Jersey farm*

Depth of Surface Soil	Yield Bu/Acre	Increase over 3″ Depth Per cent	Increase 1941 Season Per cent	Increase 1942 Season Per cent
Less than 3 inches	274	—	—	—
3-6 inches	302	10	10	10
6-9 inches	325	19	17	20
Over 9 inches	343	26	18	34

from different depths of surface soil. These results have been obtained from a single field where intensive studies have been in progress. The values shown represent the two-year average yields from 56 separately measured areas each two rows wide and 50 feet long. The fertilization and cultural practices were exactly the same over all these areas. It appears that the yield differences are a result of the differences in depth of remaining surface soil. Individual yields for the 1941 and 1942 seasons are not shown, but the last two columns of table 6 show the percentage increase in yield over the most eroded area for each of these years. Under the relatively more favorable growing conditions of the 1942 season, the increase in yield with increased depth of surface soil was greater than that observed in 1941. However, there was a marked increase in yield on the uneroded areas during each of these years.

It was pointed out earlier that organic matter in the surface soil not only exerts a beneficial effect on the physical properties of the soil, but also furnishes nitrogen for plant growth. Additional information on this was obtained from another study on the same area. Fertilizer

nitrogen, as ammonium sulphate, was applied at the rate of 250 pounds per acre in two strips across the field. This application was in addition to the regular fertilizer application on the entire field. The strips were so located that they included parts of both the uneroded and eroded areas of the field. The influence of this treatment on yield is shown by the data in table 6A. On areas where more than 6 inches of surface

TABLE 6A.—*The influence of nitrogen fertilization on yields of potatoes from eroded and non-eroded areas*

Depth of Surface Soil	Nitrogen Added Yield—Bu/Acre	No Nitrogen Added Yield—Bu/Acre
Over 6 inches	296	298
Less than 6 inches	292	220

soil remained in place, the additional nitrogen application did not influence the yield. Where erosion losses had reduced surface soil to depths varying from 0 to 6 inches, there was a marked increase in yield resulting from the nitrogen treatment. These values include only the 1942 season and are based on a reduced number of sample areas. Since this is the case, the results should be considered tentative. However, the trend indicated may be of considerable significance in planning for the most efficient utilization of the limited supplies of nitrogen fertilizer now available.

During the 1942 season, the investigations were extended to six additional farms in Monmouth and Middlesex counties. The data obtained are shown in table 7. The trend, in general, is the same as that shown in the previously-reported study. A 13 per cent increase was found in yields for 3 to 6 inch depths of surface soil as compared with areas having a 0 to 3-inch depth. An additional 9 per cent increase was found where the depth increased from 3-6 to more than 6 inches. On farms where a direct comparison between 0 to 3-inch and over 6-inch depths were possible, a 36 per cent increase in yield on the deeper topsoil layer was found.

These results, together with similar ones obtained in other localities, show a definite and immediate benefit of conservation activities in terms of crop production. During years in the immediate future, it will be necessary to increase the acreage of clean-tilled crops and intensify the use of all crop land. This is essential in order to produce the quantities of food and fiber required. The use of sound conservation prac-

tices will not only reduce the wastage of soil resources but will increase production both during and after this emergency period.

TABLE 7.—*Potato yields on different depths of surface soil on six New Jersey farms*

No. of Areas Sampled	Yield—Bushels per Acre			Increase Per cent
	0-3 Inches Surface Soil	3-6 Inches Surface Soil	Over 6 Inches Surface Soil	
24	230.2	260.0		13
24		275.7	301.5	9
32	229.5		312.3	36
Average	229.8	267.8	306.9	

SUMMARY

The amounts of organic matter, phosphorus, potassium, and calcium removed in the eroded material from a Collington sandy loam are reported.

The eroded material averaged 4 times the organic matter, 1.5 times the phosphorus, 1.4 times the potassium, and 2.3 times the calcium contained in the soil from which the erosion occurred.

Comparisons are made between potato yields from areas that have undergone different degrees of erosion as indicated by the remaining depth of surface soil.

On areas where the surface soil varied from 3 to 6 inches in depth, the yield of potatoes was 13 per cent higher than from areas having less than 3 inches of surface soil. A comparison of yields from areas having 3-6 inches and more than 6 inches of surface soil remaining showed a 9 per cent increase in yield on the greater depth. Records from one year's data show a 36 per cent increase in yield for areas having more than 6 inches of surface soil as compared with areas having less than 3 inches of the surface layer remaining in place.

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REPORT OF THE SEED POTATO CERTIFICATION COMMITTEE, POTATO ASSOCIATION OF AMERICA

In lieu of the regular report submitted to the Annual Meetings, the Committee submits the following report. Without going through the formality of a regular meeting, and with war conditions as a back drop, many suggestions are made with the prime motive of stressing food for war.

1. The Committee recommends that certification agencies use every means at their disposal to encourage the production of quality seed potatoes.

2. High standards and high quality, regardless of shortage of man power for inspection, should be maintained.

3. States in which Foundation Seed Programs are already established should maintain these programs. The states without such a program should introduce and subsidize it, if necessary.

4. If possible, special courses should be established in agricultural colleges, to train inspectors. Deferment from military services should be stressed.

5. Since research work on Ring Rot control is being curtailed, every effort should be made to complete the work already initiated. Information that has not been released, should be made available, particularly to the Seed Certification agencies.

6. Until it has been shown that slight infections do not cause trouble, the zero tolerance in Ring Rot should be continued.

7. Due to the disparity between certification standards in various states, a clearing house should be established to work for uniformity. This uniformity is especially desirable on the shipping grades.

8. The efforts to encourage good relations with South American countries should be continued, in view of possible future markets. The U. S. Department of Agriculture is suggested as the agency to accomplish this.

9. In view of previous activity on the part of the International Crop Improvement Association, with regard to regulatory matters on seed certification, it is suggested that the Potato Association of America work out a joint committee to consider seed potato problems.

10. Research workers should spend more time with direct control measures, for increased crop production, in view of war time needs.

MARX KOEHNKE, Nebraska, *Chairman*
HENRY DARLING, Wisconsin
R. J. HASKELL, U. S. D. A.
A. G. TOLAAS, Minnesota
G. H. STARR, Wyoming
E. L. NEWDICK, Maine
A. H. EDDINS, Florida

SECTIONAL NOTES

ALABAMA

There has been a considerable reduction in the 1943 commercial acreage of potatoes in South Alabama. Early local estimates placed the acreage around 65 per cent of last year's; and present estimates place the acreage nearer 75 per cent of that of last season. This marks a much greater reduction of acreage in South Alabama than in the competing states of California, South Carolina, and Texas. The reduction in acreage has been due to a number of causes, most important of which has been labor. The need for labor and the high prices paid for labor at Mobile, Pensacola and other places engaged in war contracts have left little local farm labor available. Price ceilings in the face of scarce and high-priced labor made potato production on the scale of two years ago a little hazardous for the South Alabama section.

Ideal weather prevailed at planting time, although rather cool weather has prevailed during late February and March. A temperature of 19° was reached during the first week of March at which time extra early plantings were killed to the ground. The acreage killed was insignificant.

The prospects for labor needed to harvest the crop are not bright. In addition to this local trucks are not adequate for moving the crop from the field to the graders and cars.

The Bliss Triumph continues to be the leading variety. Some White Rose and Katahdins have been planted. With a normal growing season, production may yet equal that of last year when extremely unfavorable weather conditions reduced stands as much as 30 to 50 per cent.

Certified seed were adequate this year, and there appeared to be no scarcity of fertilizers. (Mar. 12.)—L. M. WARE.

CALIFORNIA

Potato markets on the Pacific Coast are resting under the shadow of priority A-10, under W. P. B. Order which is taking all number one potatoes for the needs of the Armed Forces.

The trade is doing its best to get along with such number two's as are released.

The trackholdings are very light and the jobbers' houses almost destitute of supplies.

The next hope is the Edison/Shafter Deal which customarily starts the 1st of April but which this year will probably open later on account of the uniform price ceiling of $2.15 which extends throughout the Deal with no added bonus for early harvesting.

Shafter growers have protested against the Kern County ceiling which is .25 cwt. lower than any competitive district.

Carlot shippers are finding it almost impossible to operate under present regulations as the .10 markup for carlot shipments out of which brokerage and all other expenses must be borne, makes carlot shipments impossible.

During the months of April, May, June, July and August, 1941, the markets—New York, Philadelphia, Pittsburgh, Chicago, Cincinnati, Cleveland, Detroit, Minneapolis, St. Paul, Dallas, Denver, Ft. Worth, all requiring a haul ranging from 1419 miles to 3217 miles from the California shipping points—consumed 4098 cars of California potatoes.

Obviously, carlot shippers cannot undertake delivery of perishable new crop California potatoes in these distant markets unless reasonable markup is permitted. (Mar. 5).—E. MARX.

We have and will plant altogether in Kern County about 35,000 acres. This is a slight increase compared with 1942. At least, this is our estimate. Of this 35,000 about 3000 acres will be planted in the mountain area and will not be planted until June. The remainder of the crop, however, will be planted by the 20th of March. We will start harvesting by the 1st of April in our earliest section, providing the O. P. A. ceiling price is changed. If it is not changed we probably will not harvest any potatoes until the 15th or 20th of April. Our growers are attempting to get a graduated price ceiling so as to induce the crop to move to market by weeks, as it has in the past as far as volume is concerned. Should the price ceiling remain the same for each month—April, May and June—then every grower will leave his potatoes in the ground as long as he can in order to get the greatest yield possible. This, of course, would mean that instead of marketing less than 400 cars

per day at our peak we would probably be attempting to market 500 to 600 cars per day. The growers are now attempting to get a price scale downward from the beginning of marketing. For example, $3.25 or higher for the first fifteen days of April; $3.00 for the last fifteen days of April and so on down to the last week in June to $2.50 per hundred. A committee is now in Washington attempting to secure some such adjustment instead of the present $2.15 per hundred straight across the board for April, May and June. Many growers here understood when the first price ceiling of $2.55 was set that this was to be the price instead of the recent $2.15 which has been established, so there is considerable confusion among the growers of this county.

The crop was planted and is being planted in fairly satisfactory condition. Some men are planting when the soil is too wet, and this probably will tend to reduce the quality slightly. The principal thing that has kept our estimates at 35,000 acres is that good seed has not been available for any additional acres. The growers are now finding that in 1942 they paid approximately twice as much per acre for labor as they paid in 1941. They anticipate paying more than twice as much in 1943 as they paid in 1941. Farm labor wage for common labor today in this county ranges from 60 to 75 cents per hour, without board or lodging. Shed operators are paying from 65 to 80 cents per hour for grading and packing. Many growers anticipate that this will be increased to at least a dollar per hour in the 1943 packing season. Many growers are highly concerned over the possibility of not being able to get their potatoes harvested in 1943. (Mar. 8).—M. A. LINDSAY.

COLORADO

Colorado has moved about 11,000 cars of potatoes to date and it is estimated that there are about 2,500 cars left. Most of these will be moved during March and the small remaining supplies will undoubtedly clean up in April. These figures on shipments lead to some interesting information. Colorado has one of the highest potato yields on record this year and yet these shipments indicate that only 81 sacks of potatoes were sent to market from each acre planted in the state. Growers could easily increase the amount sent to market by at least 50 per cent without any increase in acreage, if only the best known production practices were followed. In a series of meetings, growers have been asked to set, as their goal, 150 sacks of potatoes from each acre of potatoes planted.

Certified seed has cleaned up at least two months earlier than usual, despite the fact that the crop was the largest in history. The supply is

still short and the San Luis Valley, where it has been our habit to plant only one-drop seed, will cut more seed than ever before. Last year six cutting machines were built. These machines consist of six circular knives, revolving in tanks of boiling water,—for sterilization. The cut seed is carried on a belt to a sacker at the end of the machine. Women do most of the cutting and average as high as 40 or 50 sacks per day each. Six or eight additional machines are required this year and considerable difficulty is being experienced in obtaining priorities from W. P. B.

Last fall after harvest, many growers declared they would never plant another potato, because they had so much labor trouble. It now appears, however, that the same acreage will again be planted, as rotations are set up for potato production. No substitute crop with fewer problems has appeared and many growers have as much as $20,000 invested in machinery. Most growers now believe that somehow the labor necessary for harvesting will be provided. (Mar. 10).—C. H. METZGER.

GEORGIA

Plans have been completed and the seed stock obtained for the increased potato acreage in the state this year. Planting will begin in the main crop section about the 25th of March and will terminate about the 10th of April. Indications are that soil and moisture conditions will be most ideal for good stands. (Mar. 9).—H. L. COCHRAN.

IDAHO

As it looks now we will have the biggest acreage that the state has known. I am also making a rash prophecy to the effect that while we may have a greater total production of potatoes, I am looking for the lowest yield per acre that we have experienced for many years. My reason for this statement is that there will be a lot of land planted to potatoes that was either in potatoes, sugar beets, beans or grain last year rather than alfalfa, and that owing to the scarcity of certified seed there will be a lot of very inferior seed planted this coming season. Another factor will be that of Doctors, Attorneys and other non-agriculturally minded individuals going into the game this season. Of course the present price of potatoes is good and is practically the same throughout the country and the promise of high prices next year will surely have its effect on our 1943 potato planting. (Mar. 10).—E. R. BENNETT.

LOUISIANA

The acreage goal for Louisiana for 1943 is 47,000 acres in Irish potatoes. This includes all plantings, commercial, home, and local markets. In 1942, 175,000 100-pound sacks of seed potatoes came into Louisiana. This year more than 250,000 100-pound sacks of seed potatoes have already entered the state. This will give an indication of the intended increase compared with 1942. Usually in Louisiana we anticipate using 400-600 pounds of seed potatoes to an acre. If the amount of seed is used as a guide there is an indication that the goal will be reached this year, or perhaps, slightly surpassed.

Most of the Irish potatoes have been planted, and some are still being planted at this time. (Mar. 6).—A. C. MOREAU.

MAINE

Demand and markets for potatoes that we have dreamed about and thought would never exist, have lately been very much in evidence. Five years ago we would have regarded present potato conditions as Utopia. But now that we find them, there are a number of unpleasant situations developing, too.

For example, Black Market operations in selected seed, making it difficult for the ones who want to play the game straight to do business.

We have been faced too, with refrigerator car shortages, labor shortages, insufficient supply of bags, and one thing or another to cause trouble and create uncertainty.

Even with the difficulties, however, the state is five thousand cars ahead of last season, and these have been loaded considerably heavier than in previous years. The old arguments concerning how many potatoes Maine will ship, have already started. It is a safe estimate that the shipments will total more than 40,000 cars, but less than 45,000. A good estimate would be half way between.

Prospects for next year's crop are growing brighter, as evidence accumulates of increased supplies of fertilizer, new machinery and machine repairs. I would venture now the prediction that we will find enough fertilizer available, of the new grades, to plant a substantial increased acreage.

Prospects are favorable for at least a 10 per cent increase,—probably more. The amount of the increase will depend on the supplies and machines available, a drastic reduction of quotas by the selective service boards, and last but not least, favorable weather at planting time.

There is a marked change in the policy of the Selective Service Board here now, resulting from recent legislation and directives from Washington. Farm labor is now exempted, and the local boards are doing their best to assist growers in retaining essential labor. It is unfortunate that this was not done earlier but we can be grateful for the revised policy now in effect.

Regardless of difficulties, and regardless of handicaps of all kinds, we all have a job to do in producing as much food as possible. Taking part in a global war means tremendous changes in our civilian economy. It is no wonder some mistakes have been made. The miracle is that we have accomplished so much in so short a time. We now have a chance to do our part here, and make some real contributions to our national effort.

Of interest here in Maine and elsewhere among state educational circles, is the appointment of Dean A. L. Deering in charge of all Agricultural activities of our University. He will continue as Director of Extension Service and Dean of the College of Agriculture, and now will have supervision over the research programs of the Experiment Station, with Dr. Griffee remaining as active administrative head. It is confidently expected that greater coordination and efficiency will result from this administrative change.

Never have we had bigger demand for seed, both certified and selected than is now true. Black Market operations are responsible for the selected seed demand since there are no ceilings on this grade. There is a big increase in the legitimate demand, too. This indicates increased plantings throughout the territory that Maine supplies with seed. (Mar. 15).—FRANK W. HUSSEY.

MICHIGAN

Indications are that the acreage of potatoes in Michigan this year will show some increase compared with last season. Table stock growers have purchased 75 to 80 per cent more seed than was purchased in the state last year. Most of the large commercial growers intend to make increases.

Growers are not generally concerned about incentive payments by the Government. The feeling is that the only thing standing in the way of increased acreage is the Black Market. It is questionable how much Certified Seed has moved, or will be moved, into table consumption by way of the Black Market, but it is very obvious that a large amount of good Uncertified Seed, that should be used for planting, is

finding its way into table stock channels through the Black Markets. (Mar. 11).—H. A. Reiley.

NEBRASKA

The supply of potatoes in Nebraska is rapidly approaching the vanishing point on this date (March 13th). Both table stock and seed potatoes have sold readily since the latter part of February. The price situation has been hectic, because of Black Market activities in seed potatoes. As a result of the Black Market activities, somewhat higher prices have been obtained by growers, but in all probability, the profits as a whole, are going to the dealers, who are taking advantage of the situation. The legitimate dealer, who is still handling table stock covered by price ceilings, under the O. P. A., has been severely penalized in cases ranging from 25 cents to $1.00 per cwt. Whether or not this situation is brought under control depends upon further actions upon the part of the O. P. A., which actions have been promised at this time.

The demand for seed potatoes, locally, has been very great since the latter part of January. The anticipated reduction in acreage at the time of harvest last fall probably will not develop. At the present time it appears that growers will plant nearly the same acreage that they planted in 1942, though slight reductions are in prospect. This applies to the commercial planting, as well as to the certified.

In common with most of the country, serious labor difficulties face the farmer, in addition to facing difficulties in getting repairs or new machinery.

When the season drew to a close, the potato farmer was finally getting to the end of his difficulties with the serious frost which occurred about three weeks before harvest, on the 25th of September. The losses due to this freeze ranged from 15 to 30 per cent, and the troubles directly or indirectly connected with this, have continued throughout the season. Within the memory of the writer, this was the worst season encountered by growers, from an all over standpoint. Despite the poor prospects for the coming season, it is difficult to imagine that new growers will have more trouble than they experienced during the last season. (Mar. 13). —Marx Koehnke.

NEW JERSEY

New Jersey potato growers have been asked to increase their potato acreage by 25 per cent. In order to meet this quota we will have to plant 70,000 acres, or 14,000 more than in 1942. Approximately 154,000 extra sacks of seed and 14,000 additional tons of fertilizer will

be required to plant this extra acreage. Most of our local fertilizer manufacturers have experienced some difficulty in obtaining nitrogen or potash, but they are hopeful that sufficient quantities will be received to enable the growers to plant the increased acreage. The chief bottle neck right now seems to be labor—some mixers are so short-handed that they are afraid they will not get all of the necessary fertilizer mixed to care for the demands of the potato crop.

Reports from several reliable sources indicate that the potato growers will increase their planting at least 15 per cent. The greatest increase will be in Burlington County where present indications point to 30 per cent. A fair portion of this increase will be at the expense of the tomato acreage. This will be caused largely by shortage of labor which must be available for harvesting tomatoes when they are ready for the market, whereas potatoes may be harvested over a longer period of time without loss to the crop. South Jersey counties will increase their acreages only about 5 per cent, whereas Central Jersey's increase will vary from approximately 15 to 20 per cent. All estimates may be reduced if the price of seed is allowed to continue to rise. At the present time some dealers are asking \$4.50 to \$5.50 per hundred pounds.

Our growers are greatly concerned over the labor situation but their attitude seems to be that they will take a chance on getting the crop harvested. In view of the very great need for potatoes they can't believe that the American people will permit them to rot in the ground.

It is anticipated that our planting operations will begin about the first of April. (Mar. 15).—J. C. CAMPBELL.

NORTH CAROLINA

I have just returned (March. 12) from Eastern North Carolina where I found growers busily engaged in the completion of their plantings. One large county, with a quota of 7400 acres, was about 90 per cent complete and another, with a quota of 3400 acres, about 60 per cent planted. It is indicated that county goals, generally, will be reached in the early belt and some exceeded.

Seed is scarce and high, but all growers with whom I have talked had sufficient seed on hand to complete their acreage. Every one is concerned about the labor situation which is more acute in some sections than in others. (Mar. 13).—M. E. GARDNER.

OREGON

The potato situation has not changed materially during the past

month. Our food sign-up, now about 95 to 96 per cent complete, shows an acreage this year in Klamath county of 12,719 of potatoes as compared with 10,358 on the same farms in 1942. This acreage naturally shows a substantial increase. There is one proviso of course in this sign-up, as a portion of this increase depends upon the ability of our growers to secure ammonium phosphate (16-20), which has given such remarkable results in increasing potato yields on the sandy soils in this area.

All of our remaining 1942 potato crop has been taken over by the Army and shipments no doubt will be completed 30 to 40 days earlier than usual. We have shipped a total of 6,230 cars up to the 1st of March. Our total shipments will possibly not exceed 7,500 acres from the 1942 crop. The armed forces seem quite desirous of securing all the Russet potatoes possible for overseas shipment. Thick-skinned as they are they do not deteriorate in shipping as many other thin-skinned varieties do.

We anticipate quite an increase in certified seed this year. More rigid rules will be in effect than heretofore, particularly regarding storing, grading, and tagging certified seed stock. All bins where certified seed is stored will be identified by diagram, posters and other identification means, which should improve our certification work. This district is short of competent farm labor and new growers and old growers who are enlarging their operations find it almost impossible to obtain any new equipment or other needed supplies. (Mar. 9).—C. A. HENDERSON.

PENNSYLVANIA

Pennsylvania's increase in the 1943 potato acreage allotment is approximately 44,000 acres. Last year our growers planted 167,000 acres. The goal for this year was set at 211,000. Since most of this increase is to be absorbed by the larger or commercial grower, it is estimated that in order to plant this increase, it will require about 1,000,000 bushels of seed potatoes,—assuming that this group of growers will plant in the neighborhood of 23 bushels of seed to the acre.

Many of our seed growers intend to increase their planting this year about 20 per cent or more. If our table stock growers throughout the state expect to make similar increases, the call for seed will be tremendous. A number of growers have already reported difficulty in locating seed to fill their requirements.

Prices for certified seed have ranged from $1.65 to $2.40 per bushel

at the grower's storage. Our growers are not accepting any more orders, as the supply of seed has been exhausted.

Several weeks ago while driving through Potter County, Mr. Craighead called my attention to a Beaver colony along Route 6 on the main road from Erie to New York. When it was pointed out to me, I had to stretch my imagination to recognize it. Two weeks later this same colony had cleared every usable sapling on several acres of ground and constructed a series of dams and one large colony home. These dams are on a small mountain stream and one of them is not more than 30 feet from the concrete road. (Mar. 12).—K. W. LAUER.

SOUTH CAROLINA

The acreage of Irish potatoes in South Carolina is slightly greater than that planted in 1942. It is estimated that approximately 85 per cent of the commercial acreage was planted with certified seed. That was gratifying, for several years ago at least 50 per cent of the seed potatoes shipped into this state were non-certified.

Cold injury was the most obvious complaint of growers regarding their seed potatoes. Tubers that had been frozen were found in many carlots. In most cars the damage was negligible. However, in about 10 per cent of the carlots the percentage of frozen tubers ranged from 2 to 15 per cent. In cases where the damage was negligible the tubers evidently had been frozen in storage, probably from being exposed to cold near a crack or opening. The damage of most concern occurred in transit usually in the lower layer of bags in the cars without sufficient padding.

Scab was entirely too prevalent on a few lots of potatoes. Growers in this area are especially leery of too much scab on the seed-tubers, for in recent years scab has caused some growers to lose several cars of potatoes. In 1942 one grower lost the entire crop on approximately 20 acres because of severe scab infection.

Ring rot was not found, or reported, in any of the seed lots, and net necrosis was also very scarce in most of the lots. Stem-end browning was not at all prevalent in seed tubers in 1943 in contrast to being very noticeable in a high percentage of tubers in 1941 and 1942. Some tubers infected with the late blight fungus were found in most lots of seed this season. A considerable percentage of the tubers in several cars of non-certified Pontiac showed late blight infection.

During recent years our growers have evidenced a willingness to try newer varieties. An estimate of the percentage of the total com-

mercial acreage that is planted in 1943 with various varieties follow: Irish Cobbler, 65; Katahdin, 15; Pontiac, 7; Bliss Triumph, 6; Sebago, 3; Green Mountain, 3; White Rose, ½; and Sequoia, ½. In comparison with former years this indicates a marked reduction in acreage of White Rose and Green Mountain and a marked increase of Katahdin, Pontiac, and Sebago.

Favorable weather prevailed during the planting season and most potatoes were planted prior to the 20th of February. No damage from the low temperatures that existed between Feb. 15-18 has been found or reported. The plants are beginning to emerge now (March 12) which is about two weeks earlier than normal.—So, here's hoping that we are due for an early spring and no more killing frosts. (Mar. 12).—C. N. Clayton.

TEXAS

Lower Rio Grande Valley truck crop potatoes escaped serious damage from the three cold waves which swept the South during February. On the 10th of March the crop was in excellent condition and no insects and diseases of any consequence were present in the commercial areas.

The acreage planted in South Texas is slightly below the five-year average, but yields will probably exceed the five-year average by a considerable margin. It is hoped that the price ceiling will have a stabilizing effect on seasonal price levels and will encourage growers to spread harvesting over a longer period of time. Delayed digging should increase yields at least twenty-five per cent, if normal weather conditions prevail and blight does not become a limiting factor.

Harvesting of Bliss Triumphs, could start during the last week in March and might extend well into May in the case of white varieties of the Katahdin type. Because of transportation difficulties, there is an unusually strong local demand for white-skinned varieties which have good keeping quality as well as acceptable table quality. (Mar. 10).—W. H. Friend.

VIRGINIA

Planting of the early crop of potatoes in Eastern Virginia has been delayed by cold weather and shortage of seed. Much of the area south of Accomac County is usually planted by the 1st of March, but this year only a few plantings had been made prior to that date. A few very early plantings made prior to the 14th of February had to be replanted because the seed pieces were frozen in the ground. Temperature dropped to 10° on the 15th of February and minimum temperatures were

below freezing from the 14th to the 19th of February inclusive. Several other cold periods have occurred since, but the soil did not freeze to a sufficient depth to freeze potato seed pieces that were well covered by high ridging after planting.

Definite information is not yet available regarding the total acreage that will be planted. All the seed shipped to this area has been planted and growers are awaiting the arrival of additional shipments to complete their planting. The area below the Eastern Shore peninsula will exceed the goal. It is expected that the acreage in Eastern Virginia will be considerably above that of 1942 despite all the handicaps imposed upon the growers.

The estimated cost of production on the basis of the average yield for the last five years will be at least $2.50 a hundred in sacks, F. O. B. loading points. The growers know that unless the ceiling of $2.40 a hundred is raised before harvest time they will produce at a loss should yields be average or below the average for the past five-year period. Some of this acreage is being financed by non-recourse Federal Loans which will protect the grower against loss but does not pay him a profit or even pay for use of land, equipment, and supervision, if the crop returns are insufficient to pay off the loan.

Our growers are patriotically doing all they can to help feed the nation but cannot continue to do this at a loss. Low ceilings for this area will eventually wipe out the early potato industry. Truck farmers cannot hire labor in competition with war industry in the Hampton Roads area unless the ceilings of potatoes and truck crops are set much higher than they now are. (Mar. 12).—H. H. ZIMMERLEY.

WASHINGTON

Our certified seed potato growers are just a little bit up in the air at the present time concerning seed potato acreage for 1943. In the first place, seed has been sold for commercial production to the extent that we do not have a supply of seed stock left that is of suitable quality for seed production to increase our acreage to the place where we believe it should be increased. However, we do expect a slight increase compared with that of the 1942 acreage.

There is a very active demand for seed to be used in commercial planting and also in back yard garden planting. Certified seed, not being available for this purpose, there apparently is going to be considerable seed planted of distinct inferior quality. (Mar. 6)—CHAS. D. GAINES.

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NEW BRUNSWICK, N. J.

MOHAWK: A NEW BAKING POTATO[1]

E. V. HARDENBURG[2]

Cornell University, Ithaca, N. Y.

AND

F. J. STEVENSON[3]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry Station, United States Department of Agriculture, Beltsville, Md.

INTRODUCTION

A new variety of potato should be introduced to the trade only when it is known to possess merits not present in existing varieties, for production under specific environmental conditions, or for a specific need. The Mohawk variety was named and introduced jointly by the Department of Vegetable Crops of the Cornell University Agricultural Experiment Station and the United States Department of Agriculture in 1942. Because of its desirable shape and high starch content, it is offered to the trade as a high quality baking variety which can be grown under favorable conditions in New York for successful competition with the Russet Burbank. The latter is very subject to second growth and other tuber malformations under eastern conditions.

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[1]Paper No. 251 of the Department of Vegetable Crops, Cornell University.

[2]Professor of Vegetable Crops, Cornell University.

[3]Senior Geneticist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, U. S. Department of Agriculture.

Origin

Mohawk is a selection from a cross of Green Mountain by Katahdin, formerly designated as U. S. D. A. Seedling 46,000. It was developed at Presque Isle, Maine, as part of the national potato breeding program sponsored by the United States Department of Agriculture. It has been widely tested since 1935 for yield and quality under diverse soil and climatic conditions. The results have been especially promising in New York under conditions favorable to Green Mountain and Houma. Its foliage closely resembles its Green Mountain parent, whereas the tubers combine the high market quality of Katahdin with the high baking quality of Green Mountain.

Characteristics

The outstanding characteristics of Mohawk are (1) dry, mealy quality of flesh and excellent tuber shape, making it especially well adapted for baking, (2) remarkably high percentage of marketable sized tubers, and (3) freedom from common tuber defects, such as sunburn, second growth, misshape, growth cracks, and deep eyes. In Maine cooking tests in 1941, its tubers showed about the same degree of dryness as Green Mountain. The specific gravity of these two varieties ranged between 1.100 and 1.105, with estimated starch equivalents of 18 to 19 per cent. Also in Maine, Mohawk has shown less tendency to blacken after cooking than Green Mountain. Of even greater significance in the Maine tests is the fact that Mohawk has shown no tendency to net necrosis as a current-season symptom of leaf roll, which tuber defect is very serious in Green Mountain. Quality tests made by the New York State College of Home Economics on the 1939 crop grown both on the Sassafras silt loam soils of Long Island and the Lordstown silt loam soil near Ithaca, N. Y., resulted in ranking Mohawk among the mealiest varieties.

With respect to disease resistance, this new variety is resistant to mild mosaic and to net necrosis due to leaf roll. In this it resembles its Katahdin parent. It is susceptible to leaf roll and to date there is no evidence that it is resistant to either scab or late blight. In a comparison of 16 varieties grown on muck in Wayne County in 1942, Mohawk showed less tipburn injury than any other varieties except Sequoia and Katahdin, and less flea-beetle injury than any other varieties except Sequoia and Houma. In the tests at the Bureau of Plant Industry Station, Beltsville, Maryland, it was not quite as resistant to hopper-

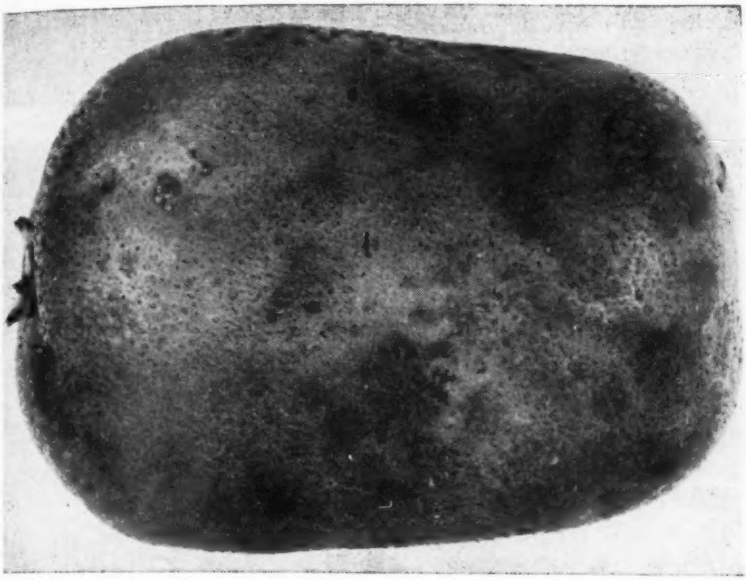

FIGURE 1—Mohawk: single tuber showing oblong-flattened shape, flaky skin.

burn as Sequoia but much more resistant than Irish Cobbler and Triumph.

Adaptation

During the 8-year period 1935-'42, inclusive, Mohawk has been systematically tested on heavy and light soils, on muck soils, and under widely differing ranges of soil moisture and seasonal temperatures. Yields show it to be tolerant of varying conditions of seasonal rainfall, but on the heavier soils the tubers tend to lose their normally regular shape. It is best adapted to the lighter soils, to muck, and to the cooler regions found in northern New York and the higher altitudes elsewhere. The plant sets relatively few tubers, a high percentage of which reach marketable size. It matures in approximately the same period as Green Mountain and usually a little earlier than Katahdin in New York.

Yield Tests

Mohawk has been tested for yield on the Aroostook Farm, Presque Isle, Maine, from 1935 to 1942, with the exception of 1938. In these

TABLE 1—*Yields of the Mohawk variety of potato as compared with standard varieties at Presque Isle, Maine, from 1935 to 1942,[1] inclusive. Yield data are given in bushels of U. S. No. 1 tubers per acre.*

Variety	Yield per Acre							Mean Yield per Acre	Yield U. S. No. 1 Tubers
	1935	1936	1937	1939	1940	1941	1942		
	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels	Per cent
Mohawk	351	504	310	222	251	450	229	331	94
Green Mountain	354	518	405	195	337	429	273	359	91
Chippewa	310	480	372	192	276	369	233	319	87
Houma	287	471	355	165	323	343	200	306	84
Katahdin	269	432	274	135	237	356	216	274	88
Sebago	317	492	351	197	260	376	197	313	91
2 x S.E. of difference between means	39	59	43	37	40	50	40	16	

[1]No yield data taken in 1938.

tests, yield data were obtained for six replications of 25-hills each grown in randomized blocks. More extensive tests of Mohawk in comparison with other varieties have been made in New York State at the Cornell Agricultural Experiment Station, Ithaca, since 1935, and in a number of county tests since 1937, with the exception of 1941.

The average yields of Mohawk and the percentages of U. S. No. 1 tubers produced in the Maine plots are shown in table 1.

The data in table 1 indicate that on the basis of a 7-year average, Mohawk significantly outyielded Houma, Katahdin, and Sebago. It was in the same class as Chippewa but was outyielded by Green Mountain. Mohawk also produced a higher percentage of U. S. No. 1 tubers than any of the other varieties.

Yield trials, carefully replicated, have been made at Ithaca, N. Y., since 1935 to compare with all of the commercially important varieties grown in that state. With the exception of Rural and sometimes Green Mountain, the seedstocks tested were provided by the United States Department of Agriculture and shipped from Aroostook Farm, Presque Isle, Maine. Although other new varieties and seedlings were included annually in these tests, yields from only the established varieties are reported here. The yield results for the Cornell trials for the years 1935 to 1942 inclusive are shown in table 2.

In the tests at Ithaca, Mohawk significantly outyielded Chippewa and Katahdin, approximated the yields of Green Mountain and Houma, and was significantly outyielded by Sebago and Rural. As in the Maine trials, Mohawk averaged a higher percentage of No. 1 size tubers than any other variety.

During the years 1937, 1938, 1939, 1940, and 1942, Mohawk was tested for yield in comparison with the six important mid-season and late varieties in many different counties. Samples of the same seed as that tested at Ithaca were sent to each county and by cooperative arrangement with the farm bureaus planted according to a uniform plan. No Mohawk seed was available for inclusion in these tests in 1941. For the 5 years a total of 56 yield trials was made. The number of county tests made each year, the annual average yields, the unweighted 5-year average, and the weighted average yield of No. 1 size potatoes for the 56 tests are reported in table 3.

On the basis of either the 5-year averages or the weighted averages for the 56 tests, yield differences among these seven varieties are, in most instances, not significant. The data in table 3, however, indicate that Mohawk was outyielded by none of the other six six varieties and that it significantly outyielded Chippewa, Katahdin, and Rural.

TABLE 2—*Yields of Mohawk in comparison with other varieties at the Cornell University Experiment Station, Ithaca, N. Y., 1935 to 1942, inclusive. Yield data are given in bushels of U. S. No. 1 tubers per acre.*

Variety	Yield per Acre								Mean Yield per Acre	Yield of U. S. No. 1 Tubers
	1935	1936	1937	1938	1939	1940	1941	1942		
	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels	Per cent
Mohawk	175	172	165	146	178	212	151	207	175	87
Green Mountain	278	150	219	129	158	202	225	223	198	83
Houma	240	169	160	73	136	191	178	248	174	79
Chippewa	143	91	234	79	119	160	54	255	142	71
Katahdin	194	99	174	122	101	138	147	195	146	85
Sebago	—	—	375	115	145	249	162	254	217[1]	86
Rural	223	231	385	166	152	230	244	298	241	86

[1]6-year average.

TABLE 3—*Comparative yield data in bushels of U. S. No. 1 tubers per acre of Mohawk and six other established varieties tested in various counties of New York.*

Variety	Yield per Acre					Average Yield on Basis of 5-year Average	Average Yield Weighted on Basis of 56 Tests	Rank on Basis of 56 Tests
	1937	1938	1939	1940	1942			
	7 Tests	14 Tests	13 Tests	12 Tests	10 Tests			
	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels	Bushels	Number
Mohawk	311	302	201	312	317	289	285	1
Green Mountain	346	319	204	262	315	289	283	3
Houma	352	303	182	280	338	291	282	4
Chippewa	326	296	188	282	295	277	272	6
Katahdin	287	276	190	288	286	265	262	7
Sebago	307	291	216	325	298	287	284	2
Rural	330	263	210	256	347	281	273	5

Availability of Seed Stock

Foundation seed stock of Mohawk will be multiplied by growers in New York and Maine in 1943, but no certified seed will be available until the spring of 1944.

Summary

The Mohawk variety of potatoes (U. S. D. A. Seedling 46,000) originated in Maine from a cross between Green Mountain and Katahdin. Since 1935 it has been tested for yield and quality under various sets of environmental conditions. Results have been promising in New York, especially in sections favorable for Green Mountain and Houma. Mohawk combines the high market quality of Katahdin with the high baking quality of Green Mountain. It produces high yields of mealy fleshed, regularly shaped, somewhat elongated, tubers. It is resistant to mild mosaic and moderately resistant to tip burn, flea-beetle injury, and hopperburn. Its tubers, so far, have not shown net necrosis. It is offered to the trade in New York State as a high quality baking variety.

LATE BLIGHT OF POTATOES IN COLORADO

L. A. Schaal and W. C. Edmundson[1]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, U. S. Department of Agriculture, Greeley, Colo.

Late blight, caused by the fungus *Phytophthora infestans* (Mont) de Bary, has been one of the limiting factors in the production of potatoes in the cool and moist areas of the world, but very few reports of serious, or even light damage, have come from the more arid sections that are relatively free from fogs, heavy dews, and rains during the growing season. Kreutzer and McLean (1) reported late blight as occurring in the potato fields of northern Colorado during the season of 1941, and that some damage was observed in stored tubers. The disease was also noted by the present writers on vines in the early crop area near Gilcrest, Colorado, the first week of July, 1941. These small infected

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[1]Associate pathologist and horticulturist, respectively.

areas were always confined to low wet places in the fields. No tuber rot was noted at harvest time, and the disease was considered of no great importance.

In 1942 late blight appeared in several early-crop fields during the latter part of July, but again no tuber rot was noted during harvest, which occurred throughout August.

In the northern potato-growing area of Colorado, vine infection was first noted in the late potato crop on the 12th of August. Small areas of infection were noted in many fields by the 20th of August. By the 30th of September the disease was present in practically all fields. Heavily infected spots were small in area, and the larger part of most fields showed less than 1 per cent of the plants with vine infection. Soon after the late blight was noted in August, growers were advised to spray or dust with recommended copper compounds. A few growers did spray or dust, but others did not consider that the light vine infection warranted the use of control measures. Most fields, however, had received from two to four applications of lime sulfur and zinc arsenite, a combination spray for psyllid and flea-beetle control.

On the 10th of September a field showing only a few infected leaves on widely separated plants was examined for tuber rot, and decayed tubers were found under plants that had no vine infection. Six of the 20 hills dug at random in an area of a field with no evidence of vine infection showed tuber rot. Infected vines were found for a distance of 30 to 40 feet up the rows. Several such cases were noted. The greatest amount of tuber rot was found at the lower ends of the rows where the soil was wettest. Exceptions were noted, and in one case heavy vine infection occurred at the upper end of a large field and tuber rot decreased as the distance from this infected area increased. Upon careful examination of the hills in many fields it was noted that as a rule the heaviest rot occurred in the tubers lowest in the hill and in those nearest to the irrigation ditch. This indicated that the conidia were distributed by the irrigation water, rather than carried to the surface of the tubers by rain.

At harvest, beginning in late September, many rotted tubers were found in fields showing only light vine infection. Heaviest tuber rot was usually found at the lower ends of the rows where irrigation water had stood and where vine growth was usually heaviest. In several cases the lower one-fourth of a field showed about 90 per cent tuber rot. Vine infection, however, was not always severe at the lower ends of the rows, and in some cases heavy tuber rot was found under plants

free from vine infection. The light vine infection, in most cases, did not seem to warrant the heavy tuber rot found.

There is little doubt that the practice of irrigation adds to the late blight problem. Water running down the rows during the time that conidia are being produced furnishes an excellent means of dissemination. In several of the most severely infected fields observed the growers irrigated at night and during the early morning hours, when conidia were most likely to be produced.

Colorado summers are usually characterized by hot dry days and cool dry nights. These conditions do not ordinarily favor the appearance and development of late blight. The temperature, humidity, and rainfall data indicate that the 1942 season was fairly normal and although temperatures were well within the range in which *Phytophthora infestans* can develop, the warm days would normally preclude an epidemic of late blight. During August, however, fogs occurred on 8 different days, often lasting from early morning until midday. These fogs extended the high relative humidity period on these days and provided ideal conditions for infection.

Harvesting and storage of the late-blight-infected potatoes in the northern Colorado area in 1942 constituted a real problem. A part of the crop was of the variety Bliss Triumph, and since this rot is difficult to note on a red tuber, the pickers, unfamiliar with the disease, failed to leave the infected tubers in the field. High prevailing temperatures during the first few weeks of storage made cool storage impossible. Soft-rot organisms invaded the blight-infected tubers and caused a rapid breakdown in many storage cellars. Most of the seriously rotted lots were sorted previous to the 1st of December, and approximately 15 per cent of the commercial crop was lost.

The winter of 1941-'42 was one of the coldest on record, but a heavy snowfall prevented the freezing of the soil, and many volunteer potato plants were noted in the spring of 1942. Some of these may have provided the initial infection for the 1942 epidemic.

LITERATURE CITED

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AN EVALUATION OF SLUDGE-ACID AND ALKYLATION-ACID SUPERPHOSPHATES AS SOURCES OF PHOSPHORUS IN POTATO FERTILIZERS

(Field Studies in Maine, New Jersey, Pennsylvania, and Virginia)[1]

B. E. BROWN[2]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry Station, Beltsville, Md.

J. C. CAMPBELL[3]

New Jersey Agricultural Experiment Station, New Brunswick, N. J.

ARTHUR HAWKINS[4]

Maine Agricultural Experiment Station, Orono, Maine

G. V. C. HOUGHLAND[2]

AND

K. D. JACOB[2,5]

Division of Soil and Fertilizer Investigations, Bureau of Plant Industry Station, Beltsville, Md.

INTRODUCTION

That sulphuric acid is indispensable to our war effort is evidenced by the need for large quantities of the acid in the production of many materials essential to the prosecution of modern military and naval operations. According to the Bureau of the Census, the domestic production of sulphuric acid in 1939 was equivalent to 7,615,023 short tons

[1]Conducted cooperatively by the Maine, New Jersey, and Pennsylvania Agricultural Experiment Stations; the Virginia Truck Experiment Station; and the Divisions of Fruit and Vegetable Crops and Diseases, and of Soil and Fertilizer Investigations, Bureau of Plant Industry, Agricultural Research Administration, U. S. Department of Agriculture.

[2]Respectively, senior biochemist and associate soil technologist, Division of Fruit and Vegetable Crops and Diseases, and senior chemist, Division of Soil and Fertilizer Investigations, Bureau of Plant Industry.

[3]Assistant plant pathologist, New Jersey Agricultural Experiment Station.

[4]Assistant agronomist, Maine Agricultural Experiment Station.

[5]The writers wish to acknowledge the helpful cooperation of Amos H. Fletcher, Aroostook County, Maine; Spencer Perrine, Middlesex County, and George Probasco, Monmouth County, N. J.; and Milton D. Leiby, Lehigh County, Pa.; who, besides furnishing land, looked after essential details, such as preparing the land, supplying teams, cultivating and spraying, and assisting at harvest time. Acknowledgment is also made of the helpful cooperation of A. L. Hacker, county agricultural agent of Lehigh County, Pennsylvania.

of material containing 62.18 per cent of H_2SO_4 (50° Baumé), of which the chief use (1,908,889 tons) was in the manufacture of superphosphates. In peace time the other principal uses of sulphuric acid are: in the manufacture of petroleum products, chemicals, iron and steel, coal products, other metallurgical products, paints and pigments, rayon and cellulose film, explosives, and textiles.

The defense and war programs have occasioned tremendous increases in the demands for sulphuric acid for nearly all uses, especially for the manufacture of explosives. From an agricultural standpoint, it is estimated that the quantity of sulphuric acid used in the domestic manufacture of superphosphates in 1942 exceeded the equivalent of 3,000,000 short tons of 50° Baumé material, an increase of more than 50 per cent over the consumption in 1939. Fortunately, it has been found possible thus far to avert serious shortages of sulphuric acid by making full use of existing plant capacity, by building new plants, and by utilizing the spent and waste acids resulting from the manufacture of certain products.

Production of Superphosphate with Spent Acids

Jacob (*2*)[6] states that in 1940 and 1941 quantities of ordinary superphosphate equivalent, respectively, to 163,700 and 207,596 short tons of material containing 16 per cent of available P_2O_5 were made with spent and waste sulphuric acids from the manufacture of explosives, petroleum products, pigments, dyes and alcohols; from metal refining and treating plants; and from certain chemical-treatment processes. In 1942 a far larger quantity of superphosphate was made with acid from such sources. In addition to these sources of acid, it is anticipated that in 1943 and subsequent years there will be considerable quantities of spent sulphuric acid available from the manufacture of so-called alkylation fluid for use in the production of high-octane gasoline.

The spent acid from the manufacture of alkylation fluid, like the so-called sludge acid from the refining of petroleum products,[7] contains alkyl sulfates which, when hydrolyzed with water or steam, yield a solution of sulphuric acid and a residue of hydrocarbons. The separated acid, as well as the superphosphate made therewith, is dark in color and has a pungent odor somewhat different from that of the sludge acid from petroleum refining.

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[6]Italic numbers in parentheses refer to "Literature Cited" at the end of the paper.

[7]The characteristics of the sludge acid and its use in the manufacture of superphosphate have been discussed briefly by Brown, Jacob, and Reid (*1*).

In view of the likelihood that important quantities of spent alkylation acid will be available to the fertilizer industry, it seemed desirable to conduct greenhouse and field tests to determine the effects on plant growth of superphosphate made with this acid. This paper reports the results of field tests on potatoes made in 1942 in several important potato-producing areas with alkylation-acid superphosphate and with sludge-acid and clear-acid superphosphates.[8]

Previous Investigations

Brown, Jacob and Reid (*1*) have reported results of pot-culture studies with barley, millet, oats, and sorghum, grown on Norfolk loamy fine sand (pH 5.4), which indicated, in general, that superphosphates made respectively with sludge and clear sulphuric acid were equally effective in promoting plant growth. In nitrification experiments, conducted in conjunction with these pot tests, sludge-acid superphosphate had no adverse effect on the nitrification.

In Russia, Kalinkin and Iakushkin (*3*) have indicated that phosphorite treated with spent sulphuric acid from the manufacture of nitrotoluene and from the purification of naphtha gave products which were equal in nutrient efficiency to superphosphates produced with acids from other sources. W. J. Reid, Jr. (*4*), studied the effect of fertilizer treatment on seed-corn maggot injury to spinach seedlings. He reported that a fertilizer containing sludge-acid superphosphate gave greater yields of spinach than a similar fertilizer containing clear-acid superphosphate. To some degree this effect may have been caused by the greater repellent action of the sludge-acid superphosphate against the maggots.

Results of Field Tests[9]

In establishing the field studies two plans were followed: (A) To conduct tests in cooperation with potato growers; (B) to conduct tests

[8]The alkylation-acid superphosphate was kindly supplied by the American Agricultural Chemical Co., East St. Louis, Ill. It was made experimentally by treating Tennessee brown-rock phosphate with a mixture of equal parts of alkylation and clear acids. The superphosphate contained: total P_2O_5, 19.90 per cent; water-soluble P_2O_5, 14.73 per cent; available P_2O_5, 17.18 per cent.

The sludge-acid superphosphate was a commercial material made from Florida pebble rock. It contained 20.40 per cent of available P_2O_5.

The clear-acid superphosphate used in the tests on the Amos H. Fletcher farm and the Aroostook Farm, Aroostook County, Maine, was made from the same rock as the alkylation-acid superphosphate. It contained: total P_2O_5, 19.60 per cent; water-soluble P_2O_5, 15.30 per cent; available P_2O_5, 17.74 per cent. The clear-acid superphosphate used in the other tests was made from Florida pebble-rock and contained 19.80 per cent of available P_2O_5.

[9]The results of field tests and greenhouse tests on crops other than potato will be reported in subsequent papers.

on Experiment Station land. The various field tests were established, and yield and other records obtained, under the supervision of Experiment Station and Bureau of Plant Industry representatives. The fertilizer was applied by machine in conjunction with planting the seed. The prescribed method of fertilizer placement was an individual band 2 inches on each side and slightly below the level of the lower plane of seed piece. Owing to local conditions there was some variation in the fertilizer analysis and rate of application. Specific fertilizer analyses, rates of application, and other essential information, are given for the individual locations. Conditions surrounding the various tests are given in table 1; actual yields, in table 2.

Discussion

The results recorded in table 2 require very little discussion. An examination shows clearly that all the superphosphates were just about equally efficient as sources of phosphorus in potato fertilizers. As a matter of fact, the yields were so close together that statistical analyses brought out no significant differences. No differences were noted in vine growth during the growing season.

Summary

Since uncontaminated sulphuric acid is in great demand for many war as well as peacetime materials, information on the value of spent sulphuric acid as a material for treating phosphate rock is desirable.

Two spent sulphuric acids that are available for this purpose are sludge acid from the refining of petroleum products and alkylation acid from the manufacture of so-called alkylation fluid for use in the production of high-octane gasoline. Superphosphates made from the three types of sulphuric acid—clear, sludge, and alkylation—were used as sources of phosphorus in potato fertilizers and compared in eight field tests in Maine, New Jersey, Pennsylvania, and Virginia. These various tests have indicated that fertilizers formulated with the spent-acid superphosphates are capable of producing as high yields of potatoes as superphosphate made with clear acid.

Literature Cited

1. Brown, B. E., Jacob, K. D., and Reid, F. R. 1942. Plant culture and nitrification studies with sludge-acid superphosphate. The American Fertilizer 96:7, 5-6, 24, 26.

TABLE 1—*Conditions prevailing in field tests with potatoes at different locations.*

Location of test	Soil		Replications	Potato Variety	Date	
	Type	pH			Planted	Harvested
Maine, Caribou	Caribou loam	5.2-5.4	8	Green Mountain	June 1	October 1
Maine, Presque Isle[1]...	do	5.0-5.2	8	do	May 21	October 10
Do[2]	do	5.0-5.2	6	Sebago	June 21	October 11
New Jersey, Cranbury..	Sassafras loam	5.3	9	Irish Cobbler	April 22	August 6
New Jersey, Freehold..	Collington loam	5.4	8	Katahdin	April 25	August 26
Pennsylvania, Kempton.	Berks shale loam	5.3[3]	12	Russet Rural	April 22	September 24
Virginia, Onley	Sassafras sandy loam	4.8	12	Irish Cobbler	March 13	June 2

[1]First series.
[2]Second series. Planted late: June 12. Killing frost: September 26.
[3]The pH value is usually about 6.0 to 6.5.

TABLE 2—*Yields of potatoes obtained with superphosphat es made, respectively, with clear, sludge, and alkylation acids.*

Location of test	Fertilizer Analysis	Rate per Acre	Yield per Acre with Three Types of Superphosphate and without Superphosphate			
			No Phosphate	Clear	Sludge	Alkylation
		Pounds	Bushels	Bushels	Bushels	Bushels
Maine, Caribou[1]	4-0-10	2,000	399	....	....	....
	4-4-10	2,000	....	432	....	464
	4-8-10	2,000	....	443	....	431
Maine, Aroostook Farm, Series I[2]	4-0-10	2,000	369	....	....	....
	4-4-10	2,000	....	463	484	....
	4-8-10	2,000	....	510	500	....
Maine, Aroostook Farm, Series II[3]	4-0-10	2,000	133[4]	....	....	....
	4-8-10	2,000	....	245	261	224
New Jersey, Cranbury	5-10-10	1,558	....	335.6	332[5]	....
New Jersey, Freehold	5-10-10	1,500	....	309.3	310.5[5]	....
Pennsylvania, Kempton	4-8-8	1,200	....	438.9	442.5[5]	....
Virginia, Onley	6-8-6	2,000	....	92.3	86.1[5]	....

[1]Minimum difference for significance, 43.4 bushels per acre.
[2]Minimum difference for significance, 26.3 bushels per acre.
[3]Minimum difference for significance, 28 bushels per acre.
[4]Low yield due to late planting, June 12, and early killing frost, September 26.
[5]Yield difference not significant, according to "Students" method.

NOTE: The experiments conducted in New Jersey, Pennsylvania, and Virginia did not include a no-phosphorus (N-K) mixture, but previous experiments conducted on these soils indicate that they respond to applications of available phosphates. The low yields obtained in Virginia were due to drought, which prevailed during the entire period of growth.

2. Jacob, K. D. 1942. Analysis of the production of ordinary superphosphate in the United States in the calendar years 1940 and 1941. The American Fertilizer 97:2, 5-8, 24, 26; 3, 8-11, 24, 26; 4, 10-11, 26, 27; 5, 9-11, 22, 24, 26.
3. Kalinkin, S. I., and Iakushkin, I. V. 1914. Superphosphate of different kinds in sand cultures. Ann. Inst. Agron. Moscow. 19:233-240 (from abstract in Chemical Abstracts 8:773.)
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SECTIONAL NOTES

CALIFORNIA

On the West Coast, we have, at the present time, the most pronounced shortage of potatoes that has ever been experienced in this section People stand in line waiting for the new arrivals—and all the stores are empty.

It is hoped that OPA rules will be amended where another season some reserves may be created when the old crop cleans up too fast—and the new crop is delayed—such as happened in many sections this season.

The OPA should provide for the necessary increase in price to take care of actually paid-out cold storage charges as the present graduations are insufficient to take care of the actual expense, shrinkage, handling and storage.

The Carload Distributors' function of creating a cash market for the growers and assuming the transit risks should be recognized by OPA and proper provision made to keep this important Branch of Distribution in the picture.

Growers in the western states are again showing their patriotism by increasing their potato acreages, and, with favorable growing conditions, the present acute potato shortage will be helped very greatly as the oncoming crops start moving.

Although it is true that a large percentage of the early crops were planted without full realization of ceiling prices, it is hoped that the Growers' confidence be maintained by ceilings which are generally recognized as adequate and fair and by such amendment in regulations as seem to be called for.

So far, no ceiling prices have been released for crops maturing after the 30th of June.

Growing conditions at present are favorable but there is considera-

ble uneasiness in regard to the labor situation and there is also some question with regard to car supply.

The movement of potatoes from Kern County promises to be very heavy during May and June. (Apr. 6). E. MARX.

FLORIDA

The potato crop at Hastings, Florida, was severely damaged by freezes during February and the early part of March. The temperatures recorded on the dates when these freezes occurred are as follows:

Feb. 15	25°	Feb. 28	25°
Feb. 16	26°	March 4	26°
Feb. 17	25°		

Approximately 2,000 acres of potatoes were planted in December and during the first week of January they were ruined. The fields have been plowed up and planted to other crops. In the remaining 12,-500, stands were greatly reduced in fields planted prior to the 15th of January, but in those planted during the last 10 days of January, the potatoes returned to almost perfect stands. The growth of the crop has been delayed about one month by the freezes, and digging will not start until the 10th or 15th of May.

At present, in practically all fields, the plants have a good color and are growing rapidly. Late blight has appeared in the Bliss variety which was used to replant the Katahdin and Sebago fields that were plowed up as a result of the low temperatures that occurred on the 15th and 17th of February.

If weather conditions continue to be favorable for growth for the next 30 days, good yields of potatoes should be produced in fields that have good stands of plants. (April 13). A. H. EDDINS.

The potato season in the Homestead section terminated during the week of the 5th of April. Approximately 5,000 acres were grown this season as compared with 4,500 acres in the 1941-'42 season. About 95 per cent of the acreage was planted to the Bliss Triumph variety, with the remainder planted almost entirely to the Pontiac variety.

Northern-grown, certified seed was used generally with most lots showing traces of late blight tuber rot upon arrival. Considerable immature seed arrived early in the season and much of this showed evidence of rough handling and of *Fusarium* infection upon arrival. Warm weather during storage prior to planting, coupled with lack of adequate storage facilities, caused rapid advancement of the decay and a shrinkage as high as 20 per cent in some lots of seed.

Potato late blight was the most important foliage disease as usual, killing unsprayed tops 60 to 65 days after planting. However, most of the growers were able to spray or dust regularly with little interference from rains and the control of late blight generally was excellent. Control was as effective with the fixed copper sprays as with bordeaux mixture and copper-lime dusts, and, as in past seasons, chemical injury of the foliage was more severe following the use of fungicides containing lime. In experimental test plots, yields were higher and spray injury less where Cuprocide or Copper-Hydro were used as fungicides throughout the season than where bordeaux mixture was used. Late blight tuber rot was generally negligible in the harvested crop.

Conditions were favorable for growth up to the occurrence of a frost on the 15th of February, which caused some damage to potatoes planted after the 1st of December, 1942. Potatoes planted prior to the 25th of November, were generally mature or nearly so at the time of the occurrence of this frost. Injury from aphids was less than during the previous season, as was wireworm and *Diabrotica* larval damage to the tubers. Bacterial ring rot was found in only one field planted to a single lot of seed that evidently was infected at planting time. Losses from this disease were estimated at 25 per cent for this field of 70 acres.

Yields were quite satisfactory, as a whole, ranging from 200 to 300 bushels per acre. The weather was cool and dry during harvest so that very little trouble was experienced from transit diseases. Labor was adequate during the season but growers, in general, were forced to pay a higher rate for practically all classes of labor. (Apr. 15).—G. D. Ruehle.

GEORGIA

In the early potato section of Georgia the crop is making rather slow progress on account of the recent cold weather and excessive rainfall. Approximately 3,500 acres of commercial early potatoes have been planted in the state this year.

Unfavorable weather conditions in North Georgia have slowed down planting operations to a point where they will be completed from a week to ten days later this year than is usual for this area. (April 9).—H. L. Cochran.

LOUISIANA

Having recently made a tour of our commercial Irish potato area, I would state that the crop is growing well and is in fine condition. A few scattered plantings suffered from frost injury in March, and these

probably will produce lower than normal yields. There were also some fields that had to be replanted because of excessive rain, and some of these fields have lighter than normal stand. These cases are scattered, however. Farmers are worrying about available labor to harvest the crops which should start moving in early May. The price support and ceiling schedules are fixed for Louisiana potatoes at present at $2.35 f. o. b. cars for U. S. #1 grade, and a ceiling of $2.50 per 100 lbs. on this grade. Other grades have support and ceiling prices corresponding with the grade. Farmers think the ceilings on all of the grades are too low. (April 8).—A. C. Moreau.

MISSISSIPPI

The latest commercial acreage report for Mississippi potatoes is 5,700 acres, or an increase of 90 per cent compared with that of 1942. A shortage of seed potatoes prevented a still larger increase in acreage.

Damage from frost during the early part of March was apparently negligible as few potatoes were up at that time. Though the crop is a little late it shows a fair stand and is growing nicely. Ideal weather conditions have existed for the past ten days. (April 8).—J. V. Pace.

NEBRASKA

The prospects for a potato crop in Nebraska have brightened materially with good rainfall during the last few days. This territory had a rather mild winter, and even though there was a substantial amount of snowfall, it was dry and windy the latter part of the winter, which carried off much of the moisture in the top soil. Over a period of 60 years in which weather records are available, the prospects for summer moisture are brighter when good spring moisture is obtained. Conversely, if the spring is dry, the summer is more likely to be dry. For this reason, Nebraska growers feel that their prospects are very good for this coming year.

The demand for seed potatoes has been extremely active, and practically all classes of seed potatoes have been exhausted. Of course, the demand for table stock was good, along with the seed demand. As a matter of fact, some of the growers were actually grading out cull piles that had been discarded, in an effort to recover more table stock.

The acreage of potatoes, both Certified and commercial, will probably increase over last year. The Nebraska main crop area fell down in its acreage during 1942, below the acreage planted in the previous year.

Whether we recover this acreage reduction, depends entirely upon the supply of seed. If the seed now in the hands of growers is kept in good condition until planting time, and the growers are economical in planting, a fairly substantial acreage could result. In view of the scarcity of seed, as well as its high price, this is very likely to take place.

The labor situation with the potato farmer has eased somewhat since last fall. During the past year, several defense plants and military air bases that were being built in the area or nearby, used practically all of the man power usually available for farms. That, in addition to the drafting of men from the farm, resulted in a very critical situation. Some of the Nebraska growers are in a position to utilize Japanese labor. Indians, who have previously assisted in the potato harvest, are now found doing general farm work, and the farmers report that they are quite satisfactory. Of course, the whole situation is not so satisfactory as it has been in the past, but by making numerous adjustments of one kind or another, the farmer seems to be able to look with some assurance of handling the routine labor situation with a fair degree of satisfaction. The extra labor necessary for harvest and peak periods will probably be forthcoming, at least, we have the assurance that many agencies are concentrating on this problem.

The lack of certain types of machinery or repairs for this machinery, is causing a bottleneck in many places. Since practically all of the farming operations in this area are dependent upon machinery, this is a very important phase of the entire program. (April 12).—MARX KOEHNKE.

NEW JERSEY

Approximately 65 per cent of New Jersey's potato acreage is now planted, despite an abnormally cold spring. The growers in Burlington, Cumberland, and Salem counties have planted from 80 to 90 per cent of their acreage, whereas those in the central part of the state have from 50 to 60 per cent of their acreage planted. If favorable weather prevails, the commercial acreage will be planted by the 24th of April. However, most of our small garden plots as well as our North Jersey plantings, will not be completed before the 8th of May.

Growers have been able to obtain adequate supplies of seed and fertilizer until the past week. Some dealers, at present, are not able to supply their fertilizer demands and the seed supply is also very limited. It is believed that some growers may not be able to plant their intended acreage because of insufficient supplies of seed and fertilizer. Some very inferior seed is being planted where certified seed is not available.

Supplies of table stock are practically non-existent and some good seed has been sold for table stock,—aggravating the seed situation. Some seed was frozen in the ground last week when, in some localities, the temperature dropped to 15° F. The damage is believed to be very slight, however, and will not affect the stands materially. Despite these handicaps the acreage will probably be 15 to 20 per cent greater than that of last season. (April 14).—J. C. CAMPBELL.

NORTH CAROLINA

North Carolina growers have planted 35,200 acres in the early belt. This is a 16 per cent increase above the January anticipated acreage; 10 per cent greater than the 32,000 acres grown in 1942; and 5 per cent greater than the average for the past ten years. All counties, with the exception of two, show substantial increases.

Planting was prolonged to a greater extent than usual, but most of the crop was planted under favorable conditions. Reports indicate earliest plantings coming up to good stands, and present prospects are favorable.

"On April 4 a frost which killed the plants about one inch under the ground occurred in the Aurora section. Most fields were up to approximately 75 per cent of a stand. They are just coming out again."

More injury may occur tonight. "Old Man Winter" seems reluctant to release his strangle-hold on the Southland. He certainly has "dished-it-out" this spring.

Planting has been somewhat delayed in Western Carolina because of extremely unfavorable weather conditions. The bulk of the crop is usually in the ground by the 15th of April. (Apr. 14).—M. E. GARDNER.

OREGON

Due to emphasis on potatoes as a war crop we are stepping up from 36,000 to 50,000 acres. This is the largest increase (in percentage) recorded for any of the important potato-producing states. The varieties in Eastern Oregon and in Western Oregon will be mostly Netted Gem and Burbank. There will also be a large increase for summer shipment from Malheur county in the southeastern corner of the state. This area is about 500 miles away from Portland, our only large city, and it is our only summer-shipping section.

With three dehydrators running day and night on a 24-hour basis, and application in the hopper for six or seven more, it is likely that

next year a respectable part of our crop will go the dehydrator route. This process has been improved lately, the product is better and it is made more cheaply. These dehydrated potatoes are packed into sealed cans resembling a 5-gallon tin gasoline can and they are not available for civilians. Lend-lease takes the whole thing for the army. The product is excellent for mashed potatoes and various other potato dishes. It resembles macaroni more than anything else I can think of, but the "worms" are smaller and are solid.

The largest dehydrator in the country is at Caldwell, Idaho,—just across the line from Oregon. It is designed to take 10 or more cars of potatoes per day. At present prices, dehydration is reported to be immensely profitable. Operators, however, must face the prospect that after the war their plants may be worthless.

In our Klamath area a sack of 16-20 will ordinarily produce from 25 to 30 sacks of U. S. 1 potatoes. Originally we were allotted only 69 per cent of last year's supplies, which, in the face of our expanded production, meant that we would have only 50 per cent of our needs for nitrates. There has been some modification recently, after much wrangling. The A and B classification for fertilizer sales is not working very well. Some distributors, who happen to have no growers of Class A crops among their customers, are getting plenty of fertilizer for growers of Class B crops. Potatoes are Class A, and since there are no Class B crops in our main potato areas the distributors there are very short.

We have been having more or less of a potato famine in recent weeks. The army has taken nearly all of the No. 1's and part of the No. 2's. That left culls and a few No. 2's for civilians. It has not been enough. Probably there has been some bootlegging of seed for table use at prices far over the ceiling. This has not been extensive, however, because prices for seed are very high and most consumers won't pay it, even if they were willing to buy under false pretenses. Part of the fault was caused by the rather asinine price ceiling structure, whereby potato ceilings dropped after April. Naturally, farmers crowded their marketings in order to run no chance of a glut in April. We are assured that this will be corrected another year.

Although our seed growers do not plant in western Oregon until July and in eastern Oregon until May, it is already rather certain that we will have expanded acreage entered for certification. (Apr. 9).—E. R. JACKMAN.

OREGON

It looks now as though the Klamath district will increase production about 40 per cent over that of 1942. The total acreage to be planted this year should be in the neighborhood of 23,000 acres, which is an all-time high for this district. Our seed potato supply is rather short at present.

The labor situation is not good, and our season to date has been very good, with prospects of earlier than usual planting. Interest in certified seed is increasing and we believe that our acreage will be greater than last year. (April 8).—C. A. HENDERSON.

PENNSYLVANIA

The seed potato situation in Pennsylvania is getting quite serious. Our own growers have been sold out for quite some time and dealers who have been handling seed grown outside of Pennsylvania, are also unable to supply the demand. Most of the seed shipped into Pennsylvania comes from Maine, Michigan, New York and North Dakota.

Although most of the commercial growers booked their seed in sufficient time to supply their needs, the small grower in many cases has not been able to get seed. Secretary of Agriculture Miles Horst, has appealed to the Victory Garden planter not to include potatoes in their garden this year. Since potato growing is a more specialized enterprise than growing the common garden vegetables, the Secretary pointed out that the farmer potato grower would likely be able to secure better results with the same amount of seed.

One reason for the heavy demand for seed this year, and why the smaller grower is without seed, is because of the serious Late Blight infection of 1942. Many small growers lost practically their entire crop and are now buying potatoes to eat. The A.A.A. has sent representatives to Maine to locate seed for these growers and for those who were unable to secure planting stock. Approximately 20,000 and 25,000 bushels of seed will be brought into the state as a result of their efforts. (April 14th).—K. W. LAUER.

SOUTH CAROLINA

Most of the potatoes in the coastal area of South Carolina showed good stands by the 22d-23rd of March, when, in approximately 50 per cent of the fields, frost killed the plants to the ground. Plants in other

fields were injured less severely,—a few fields escaping damage altogether. Following the frosts of the 22d and 23rd of March, the plants grew out so that they were eligible to be injured by another frost which came on the 2d of April. The injury from this frost ranged from light in some fields, to very severe in others. The frosts have delayed the development of the crop from two to three weeks.

Very little seed-piece decay has occurred this season. (April 9).—C. N. Clayton.

SOUTH DAKOTA

The potato planting will start about the 16th or 17th of April. In South Dakota the indications are that the certified acreage will be increased at least 50 per cent, which will make the acreage between 3,500 to 4,000 acres this season. Growers have kept good seed and some foundation stock has also been shipped to us. There is sufficient labor for planting. Large operators take their crew and uncut potatoes in the field and cut the potatoes as they are planted. The old stock is well cleaned up with practically no certified seed available for sale at the present time. A few lots of seed raised from certified stock in 1942 can still be purchased but it will all be used locally. Growers are very optimistic over the potato deal this year and now that assurance has been given that the incentive payment on potatoes will be made, the outlook is more promising than ever.

Earl P. Barrios, Jr., of Donaldsonville, Louisiana, has again been secured to supervise the field inspection work this season. At the present time, Mr. Barrios is in Louisiana checking over the test plots planted from South Dakota seed in Louisiana and Alabama. (Apr. 13). —John Noonan.

TEXAS

The digging of new crop Triumph potatoes is progressing rapidly under the influence of favorable weather. There is a sufficient supply of labor to handle the crop at present, but there will be lively competition for the available supply of day labor as the tomato, snap bean and onion harvest seasons advance.

Stabilized prices, resulting from the price ceiling, are encouraging many growers to delay digging until the plants are at least 90 days old. Marked increases in yield have been secured by delaying digging even as much as five days past the 75 day date line, but the incidence of scab

and growth cracks also show marked increases as the season advances. An untimely rain would result in tremendous losses of crop due to scab, Southern wilt, and tuber rots of various types.

Under the droughty conditions which prevailed this season, neither type of blight has been a factor that would justify control measures. (Apr. 12).—D. H. Friend.

VIRGINIA

Potato growers throughout eastern Virginia have been busy the past few days leveling off the ridges over the potato rows. Weather, in general, has been unusually cool with several frosts during the past week. However, practically no damage has been done by frost since only a few of the plants have as yet appeared above ground. There have been a few reports of rot which may have been caused by relatively low temperatures during the early part of March. However, it is too early to determine the full extent of this damage but it is believed to be only very slight. It is estimated that the planting in Accomac County will be about 15 per cent above that of last year, whereas Northampton County, which lies at the southern end of the Eastern Shore Peninsula, has reported no increase. It has been reported that there has been a slight increase in acreage in the counties of Norfolk, Princess Anne and Nansemond, which lie across the Bay. It is estimated that the total acreage in Virginia will be about 10 per cent greater than that of last year.

On the 23rd of March, a meeting of delegates from Maryland, Virginia, North and South Carolina, Georgia and Alabama met in conference in Norfolk to draw up a petition to the OPA requesting an increase in the ceiling price of potatoes. Mr. G. S. Ralston, of the Eastern Shore of Virginia Produce Exchange, was largely responsible in bringing these delegates together. He later carried the petition to Washington and presented it to the OPA.

The petition is too long to print here but a summary prepared by G. S. Ralston is presented below.

State	Recommended Ceilings per 100 Lbs.	Cost of Production per 100 Lbs.
Georgia	$3.50	$2.60
Florida	Asks that ceilings be removed	
Alabama	3.25	2.60
North Carolina	3.25	2.60
South Carolina	3.50	2.68
Virginia	3.25	2.58
Maryland	3.25	2.58

The delegates in meeting at Norfolk, Virginia, March 23, 1943, confined their procedure to the task of establishing accurate cost of

production figures and in recommending equitable ceiling prices, in an attempt to set up a workable production situation for the white potato, under existing Office of Price Administration operation.

This does not mean that the delegates approve the current efforts of the Office of Price Administration to control consumer prices or believe that such efforts are producing the desired results. On the contrary, many believe that the program to date to stabilize vegetable and potato prices has been ill advised and is limiting production without controlling consumer prices.

In support of that viewpoint it is pertinent to mention the following conditions:—(1) That a definite food shortage exists; (2) that normal channels of trade have been disrupted; (3) that "Black Marketing" is rampant; (4) that consumer prices are excessively high and producer income excessively low; (5) that many farms have gone out of production; (6) that farmers' planting intentions for 1943 show the desired acreage goals for essential crops have not been reached.

These are circumstances that have to be faced and overcome if adequate production and satisfactory price control are to be established.

Definitely, the first corrective step must lead to increased production—otherwise, all other efforts are vain. The delegates know that the opportunity to profit is the greatest incentive that can be used to increase production. Furthermore, increased potato acreage would quickly increase food supply at reasonable cost, due to heavy yields. Without abundant production there is no law or regulation that will control consumer prices.

The reputed ceiling price, ($2.40 per 100 lbs. for Virginia) is below cost of production, ($2.58 per 100 lbs.), and will stifle rather than increase production. The recommended ceiling price ($3.25 per 100 lbs. for Virginia) is very reasonable. It would not impose a hardship on the consumer. In fact increased production, even at considerably high farmer income level, is the only means available to protect the consumer.

Let us note that if the recommended ceiling prices were received in full, that the average Accomack County potato farmer, if all his cash crop acreage were planted to white potatoes, would have a net income of less than $1,500.00, without taking into account the hazards which every year either decrease selling prices or limit production, or both. Again, this income, in most cases, has to be divided between tenant and landlord. Can this income be termed exorbitant?

In conclusion, let us keep firmly in mind that abundant production is the greatest blessing that could be bestowed on our country. Tragedy will follow low production. The solution, for increased production, in-

sofar as it can be had, is very simple—makes production profitable. (April 6).—G. S. RALSTON.

WISCONSIN

Shipments of certified seed potatoes to the 1st of April of this year have exceeded the total amount shipped last year. The demands for seed were active during the early part of the season, and by February the bulk of the seed crop had been sold. Seed prices increased during January, February and March. Wisconsin commercial potato acreages have declined considerably during the past 10 years. According to the March issue of the Wisconsin Crop and Livestock Reporter an estimated 10,050,000 bushels were produced in 1942 as compared with the 1930-1939 average of 21,830,000 bushels. Late-blight reduced yields very heavily, being first reported in the state on the 25th of June at Madison. The season was generally favorable for blight development until the crop was harvested. It is interesting that the state-wide average yield per acre was estimated at 67 bushels whereas the average yield for certified seed was about 215 bushels per acre. A good spray program followed by most certified seed growers was largely responsible for this difference; very little tuber rot was found during bin inspection for a month to a month and a half after harvest. Increased interest is being shown in the seed program, especially the work being carried on at the Foundation Seed Farm located in Northern Wisconsin. Acreages of certified seed planted with seed stocks tracing to the Foundation Farm are increasing rapidly. Much more vigor and less disease characterize the selections being developed. Winter greenhouse tests to date have been very encouraging; the southern test plot in Alabama will be examined during the week of the 12th of April. Of the 12 varieties certified this past year the Chippewa, Cobbler, Triumph and Katahdin lead all other varieties in the order named. Unusually keen interest has been shown in the new Sebago variety which has produced high yields and has outstanding late blight tuber-rot resistance along with definite yellow dwarf resistance, particularly in commercial table stock areas. It appears to be a little early to predict acreages for 1943 but indications are that intentions to plant at present will not reach the goals requested. Growers are concerned about the labor situation,—especially the key men required to supervise field and storage operations. (Apr. 8).—H. M. DARLING.

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LATE BLIGHT OF POTATOES AND ITS CONTROL UNDER SOUTHERN CONDITIONS

A. H. Eddins*
Hastings Laboratory, Florida Agricultural Experiment Station, Hastings, Fla.
and
C. N. Clayton
S. C. Truck Experiment Station, Charleston, S. C.

Late blight attacks potatoes that are grown in the southern part of the United States, especially in seasons when the weather favors its development. It causes serious losses nearly every year in some localities in the south, particularly in Florida, but in other localities, it occurs infrequently and does little damage.

A review of the facts concerning the cause and spread of late blight shows that this disease is caused by the fungus, *Phytophthora infestans* (Mont.) de Bary, which does not live from year to year in the soil, but survives from one season to the next only in infected tubers. Thus, blight is carried from one part of the country to another in diseased potatoes used for seed. When infected seed is planted, the blight fungus may grow into the sprout, and from there into the young plant above the ground where it will produce spores on the stems and leaves if enough moisture is present and the temperature is favorable. Wind, splashing rain, tools used in cultivating the potatoes, insects, man and any animals moving through the field spread the spores from diseased to healthy plants. Under favorable temperature and moisture conditions, these spores infect healthy leaves and stems of plants on

*The authors are indebted to Plant Pathologists in 9 Southern States for supplying the information on late blight and its control. These data are summarized in table 1.

which they are deposited until large areas in the entire field are blighted. When the spores are washed from blighted plants into the soil and come in contact with the tubers, tuber rot develops if the soil is wet enough. If potatoes are dug during rainy weather when the late blight fungus is producing spores on the plants, these spores are scattered over the tubers as the plants and tubers are run over the digger. If the freshly-dug tubers are wet when picked up, and are then stored or packed without drying, the spores that are on the potatoes may germinate and infect them thus causing the late blight tuber rot.

In several states including Texas and Florida, the occurrence of blight has been traced to the planting of blighted tubers in Eastern-grown seed stock. This was demonstrated at Hastings, Florida in 1937 when many of the seed tubers were found affected with the disease. All blighted tubers detected at cutting time were discarded, but apparently many which had become infected, but in which the disease had not progressed sufficiently to be seen, were cut and planted. In fields planted with this seed, the disease was found in seed pieces within a week after planting. Many of these pieces rotted before sprouting and some produced sprouts which were killed before or soon after they emerged from the soil. Stands were reduced 10 to 20 per cent by the disease in most of the fields in the Hastings area. In many fields, some infected seed pieces produced plants and the disease appeared on the stems and leaves of these within 3 to 4 weeks after planting. The disease increased in severity and became very destructive in some fields, even when these were dusted with 20-80 copper-lime dust before stands were established, and the dustings continued at weekly intervals for 6 to 8 weeks.

Information obtained from 10 southern states on the importance of late blight and the kind and value of different fungicides used to control it, is summarized in table 1. Copper sprays or dusts are used to control the disease in those sections where it is often serious. The sprays consist of different strengths of bordeaux mixture (3-3-50 to 5-5-50); wettable Cuprocide 1½ pounds to 100 gallons of water; and Copper Hydro 40 (6 to 8 pounds to 100 gallons of water). Bordeaux mixture is the spray generally used and copper-lime dust (20-80, 25-75 and 30-70) is the most commonly used dust. Copper-arsenic-lime dust (20-20-60) is usually substituted for regular copper-lime dust in some localities, particularly in South Carolina, as a precaution against blight and to control Colorado potato beetles where the beetles are frequently of more importance than late blight. Other dusts used to a lesser extent are Copper Hydro 40, Cuprocide, Vapo Dust (Cuprocide plus Vaporol),

TABLE I—*Summary of importance of late blight and the kind and value of different fungicides used to control it in 10 Southern States*

State	Section	Importance of Late Blight	Fungicides Used	Remarks on Control	Reported by
Alabama	Gulf Coast Area	Present last 3 years; serious in 1942	Bordeaux mixture	Not good; spray not applied soon enough	Otto Brown
Florida	Goulds	Every year since 1935; epidemic and serious in occasional seasons but damage averages less than 5 per cent for section	Bordeaux mixture; Cuprocide spray; Copper Hydro 40 spray; Copper Hydro 40 dust; Cuprocide dust; Cuprocide dust with Vaporol; and copper-lime dust	Sprays give good control when properly applied; copper-lime dust losing favor	G. D. Ruehle
	Hastings	Present every year and very serious in 5 years of last 12; average annual loss 4.8 per cent	Copper-lime dust	Good when properly applied	A. H. Eddins
	Belle Glade	More prevalent in last four years; causes no trouble on fall crop but is destructive to spring crop	Bordeaux mixture; Cuprocide dust plus Vaporol	Bordeaux mixture fairly successful; Cuprocide plus Vaporol gave excellent results	G. R. Townsend
Georgia	Extreme Northern part	Occurs only occasionally	Bordeaux mixture 3-3-50 recommended	None	G. E. Thompson

TABLE 1—*Continued*

State	Section	Importance of Late Blight	Fungicides Used	Remarks on Control	Reported by
Louisiana	State	Limited to out-breaks during last 2 years	None	None	C. W. Edgerton E. L. LeClerg
Mississippi	State	Never been serious	None	None	J. A. Pinckard
North Carolina	Early potato sections	Not observed in last 2 years	None	None	L. W. Nielsen
South Carolina	State	Serious only 6 years in past 25 years; serious in 1942	Copper - arsenic - lime dust; Cuprocide; Tribasic $CuSO_4$	Copper-arsenic-lime dust used mostly to control Colorado potato beetles	C. N. Clayton
Tennessee	State	Important only 4 times in last 20 years	Bordeaux mixture	Controlled	C. D. Sherbakoff
Texas	Lower Rio Grande Valley	Occurred 2 years out of 5	Bordeaux mixture used; several more copper fungicides recommended.	5-3-50 bordeaux produced higher yields than standard bordeaux in non-blight years	G. H. Godfrey
Virginia	State	Occurs nearly every year in fall; no importance on spring crop	None mentioned	Spraying is beneficial	H. T. Cook

40-60 copper-lime, Tribasic Copper Sulphate and 16.75 per cent Cuprous
40-60 copper-lime, Trisbasic Copper Sulphate and 16.75 per cent Cuprous Oxide.

Tractor-drawn sprayers and dusters are generally used to apply the fungicides. Airplanes are rarely used for dusting now, since planes and pilots are needed for the war effort. Power sprayers, such as those used at Goulds, Florida, are equipped with 6- or 8-row drop booms each of which has 3, 4 or 5 nozzles per row. Sprays are applied with these machines at pressures varying from 350 to 400 pounds. The dusters are equipped to dust from 3 to 6 rows with 2 to 3 nozzles per row. Mules are usually used to pull small dusters, but the larger machines are operated with tractors.

The number of applications and the kind and quantity of spray or dust used at each application varies in different areas and even on different farms in the same area. At Goulds, Florida, which is typical of an area where most of the acreage is sprayed, potatoes planted after the 15th of November are sprayed 6 to 7 times at weekly intervals,—beginning when the plants are 8 to 10 inches tall. Usually 100 to 125 gallons of spray material are applied per acre at each of the earlier applications, and the better growers increase this amount to approximately 150 gallons per acre after blight begins to spread through the area.

At Hastings, Florida, where the fungicide generally used for blight control is copper-lime dust (20-80), (25-75) and (30-70), crops are dusted at the rate of 15 to 30 pounds per acre, depending upon the size of the plants. Dusting is started when the plants are 6 to 10 inches tall, or when the disease is first noticed and is continued at weekly to 10-day intervals throughout the growing season, if necessary. Dusting may be suspended during dry periods when the disease is no longer spreading and resumed during foggy, cloudy, and rainy weather when it is again active. In an average year, crops are dusted about three times. In seasons when the disease is epidemic, some crops are dusted six times or even more.

Late blight is more prevalent and destructive, year after year, in Florida than in any other Southern State, probably because Eastern-grown seed containing blight-infected tubers is used to plant the major portion of the crop, and because the temperature and moisture conditions during the winter and early spring potato-growing seasons are especially favorable for the development of the disease in this peninsular State. Here, many fungicides have been tested but the ideal one for controlling blight has not been found. Some of the copper sprays and dusts, particularly copper-lime dust, have a tendency to burn potato

foliage, and this injury may reduce yields in fields where there is no blight or in those in which the disease is not severe. In Florida, also, new potato varieties, such as the Sebago, even though mildly resistant to late blight, succumb to the disease and can not be grown profitably during blight years unless sprayed or dusted regularly.

Late blight can be controlled fairly satisfactorily most seasons, even when the disease is severe, if the potatoes are sprayed or dusted regularly with copper sprays or dusts. Poor control of the disease can be traced to several factors such as (1) using seed containing many blighted tubers, (2) ideal conditions for the development of the disease in some seasons, (3) failure of some potato growers to realize the seriousness of the disease and to apply fungicides soon enough and follow a regular dusting or spraying program while the disease is spreading, (4) poor coverage of potato foliage with fungicides due to inefficient operation of sprayers and dusters, or to the use of faulty machines, and (5) prolonged rainy periods during which the organism is disseminated and becomes very destructive in fields which become so boggy that spraying and dusting equipment can not be pulled through them making it necessary to abandon the regular dusting or spraying schedules.

POTATO CULL PILES AS A SOURCE OF LATE-BLIGHT INFECTION

Reiner Bonde[1]

Agricultural Experiment Station, Orono, Me.

and

E. S. Schultz[2]

Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

Introduction

The control of late blight continues to be a major factor in the production of potatoes in Maine and elsewhere. Maine potato farmers purchase about 7,000,000 pounds of copper fungicides annually and spend at least $1,000,000 a year for spraying and dusting potatoes for

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[1]Associate Plant Pathologist, Maine Agricultural Experiment Station.

[2]Senior Pathologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture.

the control of this disease. In spite of this extensive spraying program, the annual loss caused by late blight for the 14-year period 1924 to 1938 in Maine was nearly 4,000,000 bushels or about 9 per cent of the total crop of the state. The annual loss from late blight in Maine varies from 2 to 15 per cent.

Losses caused by late blight are not limited to Maine. The disease is present nearly every year in the New England states and epidemics are not infrequent along the entire Atlantic Seaboard from Maine to Florida. Late-blight epidemics occur also in Pennsylvania and Ohio, and occasionally the disease may be destructive in California and the lower Rio Grande Valley as well as in other potato-growing sections. In 1942 an epidemic of the disease extended westward from the eastern part of the United States into the Midwest and caused very serious losses to the potato crop in Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, and Colorado.[3] According to the A. I. F. News[4] for February-March, 1943, losses up to 50 per cent of the crop occurred in some major potato-growing areas because of late-blight epidemics in 1942.

In recent years it has seemed desirable to secure more detailed information about the primary sources of this disease and the factors which aid in its dissemination. This paper summarizes briefly the present authors' attempts to determine the primary sources of late-blight infection in Maine. Their investigations led to the demonstration of the important role that the potato "dump" or cull pile may have in the dissemination of the late-blight disease.

Previous Studies Regarding Overwintering of the Late Blight Fungus

It has been known since about 1861 that the late-blight fungus is perennial and may grow from the diseased seed tuber up the stems of the plant to the surface of the soil, where it sporulates and thereby infects the foliage. It has been assumed by the present authors and potato growers that the primary infection in the field generally originates from the diseased seed tubers which are planted in the field. However, it has been very difficult in Maine to find actual cases where late-blight epidemics have been started from infected seed tubers which had been planted in a field The writers have examined many fields over a period

[3]According to correspondence from Experiment Station employees, potato dealers, and growers.

[4]Issued by Agricultural Insecticide and Fungicide Association, New York, N. Y.

of 10 or more years in an attempt to find specific examples where late-blight epidemics have been started by planting dry-rot seed tubers. So far, they have noted only one case in a commercial field where the disease originated from a diseased seed tuber.

Attempts to Create Epidemics by Planting Dry-Rot Seed Tubers

The authors also attempted to create late-blight epidemics by actually planting infected seed potatoes in potato fields. Seed potatoes that were naturally infected with late blight were planted in a number of fields and the development of the disease carefully observed. This was done for the six-year period from 1935 to 1940.

It was surprising to the writers to find that very few of the diseased seed pieces developed infected plants. Many of the diseased seed pieces decayed rapidly when planted in the soil and no late-blight or very little resulted. A total of 1,410 diseased seed pieces were planted during the six-year period. Only four of these seed pieces produced diseased shoots which appeared above the surface of the soil. None of these diseased plants started an epidemic and the infected sprouts soon died.

During the seasons of 1941 and 1942 late-blight-infected tubers were planted in an experimental plot at Presque Isle, Maine. The parts decayed by other organisms were carefully removed to prevent complete decay of these tubers before the diseased shoots reached the surface of the soil. The results of these tests disclosed that four per cent of the infected tubers developed late-blight-infected shoots. It should be noted that the percentage of infected shoots that developed in this experimental plot probably was considerably higher than would develop from tubers planted in commercial fields, where no precautions are taken to eliminate other rots from the late-blight-infected tubers.

The writers realize fully that late blight may sometimes develop from planting dry-rot seed potatoes. However, the data presented here, as well as our general observations, indicate that the planting of diseased tubers by farmers seems not to be the most important source of the primary late-blight infection in Maine.

Potato Cull Piles as a Source of Primary Infection

A potato inspector in 1935 called the writers' attention to a local late-blight epidemic which had occurred in the vicinity of a potato cull pile located in central Aroostook County. An inspection on the 15th of July showed that the cull pile was badly infected with late blight and that the spores (conidia) were being formed in large numbers.

The disease obviously had already spread from the infected cull pile to an unsprayed potato field located 200 feet away. The plants nearest the cull pile were nearly all infected but the prevalence of the disease decreased as the distance from the pile increased and no blight spots or very few were found on plants 500 and 600 feet away. The disease also was present chiefly in the path of the winds from the southeast which in this region are often moist or rain-bearing.

The information secured in 1935 aroused the authors' interest in the role that the cull pile might have in the dissemination of late blight in Maine.

During the five-year period from 1937 to 1941 extensive surveys were made in Aroostook County to secure information on the prevalence of late blight in potato cull or dump piles. Data were secured also regarding the spread of the disease from these primary sources of infection. The surveys each year were made during the period from the 20th of June to the 10th of July, which was before most Aroostook farmers had begun to spray or dust.

The findings secured from the surveys are summarized in table 1.

TABLE 1—*Summary of late-blight infection occurring in potato cull piles during the period from June 20 to July 10 in the years 1937 to 1941.*

Year	Cull Piles Inspected		
	Total Number	Number Infected	Number from Which Spread to Fields Had Evidently Occurred
1937	95	75	15
1938	102	54	10
1939	150	83	18
1940	56	14	5
1941	14	6	4

The data in table 1 show that late-blight often develops on the potato plants growing in the cull piles during the early part of the growing season, before most growers have begun to spray.

The late-blight conidia which develop in tremendous numbers in the cull piles may be carried by the prevailing winds to neighboring fields and infect the young potato plants before the farmers have begun to spray. Early field infections spread rapidly when the weather conditions are favorable and epidemics may thus occur.

Farmers rarely notice the few scattered earliest infected leaves in their fields which have become infected as a result of spread from the cull pile. From these small unnoticed initial points of infection the disease spreads to other leaves nearby and in about ten days a rather large blight area is apparent in the field. It is at this stage of an epidemic, when large blighted spots are present in their fields, that the farmers generally take notice and begin to spray in earnest. It is then too late for the most efficient use of the spray material, and it is like attempting to put out a fire after it is well started.

The question naturally arises as to why dry-rot tubers, when planted in the field, often do not develop diseased plants while those in the cull piles are frequently infected. One reason for this is that the conditions in the cull piles are more nearly ideal for the development of the disease because a dense mass of potato vines develops which remains moist and humid for long periods of time. A single small source of infection spreads rapidly under these conditions, liberating large numbers of conidia. Under normal field conditions, the diseased shoots often die before secondary infections can occur. Also large numbers of infected tubers are concentrated in these cull piles. They sometimes may contain several hundred barrels of potatoes, many of which are infected with the disease. Furthermore, the lack of soil covering over infected tubers at or near the surface of the pile favors emergence and exposure of young shoots to late-blight infection.

Dissemination of Late Blight from Cull Piles

To secure more detailed information regarding the spread of late blight from an infected dump pile, approximately 25 barrels of cull potatoes were deposited during the months of April and May, 1938, in a pile about 100 feet from a potato field. Late blight was first noted in this cull pile on the 15th of June and by the 25th of June the plants were badly infected. Aroostook County then experienced a week of cloudy weather which was followed by a gentle wind and rain from the southeast. On the 12th of July, records were taken of the prevalence of late-blight in the potato field at different distances from the infected cull pile. The results of these observations are summarized in table 2.

These data show clearly that the infection was more abundant in closer proximity to the infected cull pile. The disease obviously had been carried from it to the potato plants in the field. Spraying at weekly intervals began about the 15th of July. The dissemination of the late-blight organism was retarded, but by no means prevented, by the spraying operations.

TABLE 2—*Late Blight in field at different distances from infected cull pile—July 12, 1938.*

Distance from Cull Pile	Plants Infected	Lesions per 100 Plants
Feet	*Per cent*	*Number*
100	98	293
200	55	93
300	21	31
400	6	9
500	0	0
600	1	1

ELIMINATION OF CULL PILES

Potato growers will always have a problem in disposing of the cull potatoes which accumulate in the process of preparing the crop for market. Many Maine farmers realize that cull piles are a menace to the potato crop, but have no definite information as to the most satisfactory method of eliminating this menace.

Some growers have destroyed the plants in their cull piles by pulling, cutting down, or digging out all of the growing plants. This requires frequent inspections to be certain that all the plants have been killed, and in many cases this method has not been successful. Other growers spray their cull piles thoroughly with Bordeaux or a blue vitriol solution to control the infection. Still others spread a thick layer of straw over the cull pile and then set it on fire. The latter method appears to meet the approval of quite a few potato growers in Maine. It is possible that herbicides can be found that will be useful for the killing of potato plants in the cull pile.

Although diligent attention to the control of late blight on dump piles by following the foregoing methods is possible, experience has shown that the average grower frequently fails to destroy the tops before infection has spread to adjoining potato fields. In view of the difficulty of destroying potato tops on cull piles, it would be much better not to accumulate waste potatoes at all. In other words, not to set the house on fire is better than to start the fire and then devise means to put it out. Disposing of waste potatoes by boiling, burning, incineration or feeding to livestock will avoid having a cull pile with infected plants and the subsequent job of spraying or destroying such tops.

Discussion of Results

It is concluded that the cull pile is the chief source of primary late blight infection in Maine and that the elimination of this source of infection would do much to prevent the early occurrence and spread of the disease in the fields. It appears very probable that the cull pile is a factor in the dissemination of the disease in other states as well. The possibility exists, however that some late-blight infection may also come from the states located farther south and gradually be carried by the air currents from crop to crop northward into Maine and other potato-growing areas.

On most of the 6,000 potato farms in Aroostook county, Maine, as well as in the yards of many potato dealers there are one or more cull piles where waste potatoes are discarded each spring. The potato shoots growing from many of these cull piles become infected with late blight and serve as the primary sources of late-blight inoculum for commercial fields. A single infected cull pile may serve to infect all of the potatoes being grown in a locality. In one case, observed in 1942, late blight had spread to fields half a mile away in the direction of the prevailing winds.

The cull pile also is a place where the Colorado potato beetle and other insects multiply in great numbers. They migrate from here to nearby potato fields where they may cause much damage and add to the expense of growing the crop. Plants with leaf roll, spindle tuber, and the mosaic diseases are found growing commonly in the cull piles, and aphids are generally present to serve as vectors of these virus diseases to the commercially-grown potatoes in the vicinity. Eliminating the cull piles would not only help to control late blight but would also be a factor in the destruction of certain harmful potato insects. It also would be helpful in destroying a likely source of spread of potato virus diseases.

DEVELOPMENT OF BLIGHT-IMMUNE VARIETIES

Donald Reddick

New York State College of Agriculture, Cornell University, Ithaca, N. Y.

It is now a century since potato blight caused by *Phytophthora infestans* was first prevalent in North America, and only two years short of a century since it created havoc in Europe and the British Isles. Almost immediately after its appearance in destructive form, efforts were made on both continents to find varieties that were resistant. At pre-

sent it is not important that these efforts were actuated by the belief that potatoes degenerate because of continued asexual propagation. The fact remains that many importations were made of potatoes from the "home of the potato" and that to this day no one has brought out of South America a potato, either seed or tuber, wild or cultivated, that has any appreciable resistance to the disease. Two recent supposed exceptions to this statement are to be noted. 1. The 3 varieties Erika, Frühnudel and Robusta which have been admitted lately to the "official list" of German varieties and introduced as blight-proof sorts are hybrids made at Dahlem and variously stated to have inherited their blight resistance from a potato obtained from the Auracanian Indians of Chile. This statement can not be denied categorically but the original stock was obtained by Professor Wittmack of Berlin from the Department of Agriculture in Washington. This was just prior to Wight's extensive explorations in South America for stocks of potatoes but does not preclude the possibility that Auracanian varieties were in the possession of the Department of Agriculture from earlier importations. When Professor Wittmack turned over his samples to workers at Dahlem, one with a mutilated label was marked W. S. This is an abbreviation for Washington Sammlung or Washington Collection and it was this sample that proved to be very highly resistant to blight. It is referred to constantly as W. S. and figures in all of their reported work. Both Doctor Schick of Müncheberg who has worked extensively with potato hybrids and the writer, who has had some experience in similar work, are agreed and have stated publicly that the described behavior and their personal experience with W. S. hybrids suggest most strongly that the mutilated label originally read *Solanum demissum*. This species has never been found outside of Mexico. It was brought to Vermont by Doctor Pringle and was grown there by William Stuart even before he took charge of the potato improvement work in the U. S. Department of Agriculture. 2. A specimen labeled *Aya papa* was sent to the writer by R. N. Salaman of Cambridge with the statement that it was of Ecuadorean origin and that it is immune to blight. The sample sent is immune. But P. T. Knappe of Estonia from whom Salaman got his sample says (in correspondence) that Aya is blight susceptible, as does S. M. Bukasof (letter) who probably sent the sample to Knappe. The Salaman plant when grown at Ithaca has the appearance and behavior of a *demissum* hybrid in about first backcross condition. It seems obvious that Aya does not have resistance to blight; and any one who has grown *demissum* hybrids in the field will understand how very

easily a tuber from such a plant, although several feet distant, could appear under the plant marked Aya.

When one recalls that the first authentic record of the occurrence of blight in South America is on potatoes grown from stock imported from Europe, it appears that we have encountered the anomalous condition that potato blight did not originate in South America, the home of the potato, but that it came from the outside, perhaps even from some other plant just as is true in the case of the ten-lined potato beetle. At any rate it seems almost incredible that the organism causing blight and the potato should have been naturally associated for many generations without either the extinction of the potato or of the development of some protective mechanism by the potato which would be exhibited at the present time in a definite resistance to the disease. This line of argument has the more weight when one searches in central Mexico and finds there several species in the wild, all of which are definitely resistant to blight or else do not contract the disease at all. In this connection it is well to note that as early as 1850 Klotzsch in Berlin had made some hybrids with *Solanum demissum* from Mexico and that some of these hybrids were in existence and were exhibited at a potato show 25 years later. This suggests a possible source of the definite resistance shown by certain European varieties such as Pepo, Praesident Krüger, Parnassia and others. It also suggests that the parasite of potato blight had its origin in Mexico and that it may have come to us on some chance importation from Mexico, presumably not on potato at all but on some closely related plant which is also susceptible to the disease.

Obviously if one is to do anything about the development of potato varieties that are resistant to blight, he must have, as foundation stock, some plants that are highly resistant or else immune to the disease. The only known place to find such stock at the present time is in central Mexico. And, of the several species to be found there, which are resistant or immune, *Solanum demissum* is the species which is being used wherever work on the problem of developing resistant varieties is in progress. None of the wild species has any possibilities as a commercial potato as it is, and, there seems little prospect of ameliorating any of them outside the tropics, except by hybridization and selection of plants which have short stolons, large tubers and the ability to begin tuber production before the advent of freezing weather.

Interspecific hybridization with acclimated sorts is indicated but when it is attempted, one encounters sterility, a difficulty which makes it practically impossible to pursue any program other than the one of taking and

making the best of what it is possible to obtain. For various reasons it would be particularly desirable to hybridize *S. polyadenium* a tuberous Mexican species which has good vigor, is immune to blight and very resistant to the attack of some of the insects which are destructive to potatoes. Despite many attempts, no one seems to have effected a cross. Certain other species having the same number of chromosomes as our domestic varieties might be expected to hybridize readily but experience has shown that they do not. *Solanum demissum* with 72 chromosomes might not be expected to cross with domestic varieties which have only 48 chromosomes, but as a matter of fact if *S. demissum* is used as female, crosses are easily effected. As stated, most or all of the workers in the field are using *demissum* as the source of blight resistance. Unfortunately, this species must be considered as a group species. The variability within the species has allowed for the identification of several varieties or subspecies and it has been found that aside from morphological characters there is wide variation in respect of blight resistance. One plant from Rio Frio which clearly belongs in the *demissum* group is actually somewhat susceptible to blight. Another plant from El Desierto, also clearly in the *demissum* group, yields a heterogeneous progeny when selfed, indicating that it is already in hybrid condition. In other words, one must know in advance that the particular plant to be employed is actually immune to the disease and this is something that can be determined only by inoculation under appropriate conditions.

Although *S. demissum* sets seeds very freely, its pollen is rarely effective when used on domestic varieties. On the other hand many of the cultivated varieties are nearly or quite devoid of good pollen. The recent development of varieties like Katahdin and Earlaine, both of which have an abundance of good pollen, simplifies the problem in that it is possible to effect crosses and thus not only determine that the immunity of *demissum* is a heritable character but at the same time avoids the introduction of undesirable characters of which *demissum* already has too many.

After a first cross has been effected there comes the problem of selfing some of the first generation hybrids. This is often very difficult or quite impossible to accomplish. Many such plants are self sterile. The easiest method is to plant a considerable number of seeds and search for plants which produce seeds in the field. Such seeds may be used safely since they are almost certainly self-fertilized; and in any event the result is almost always disappointing. The recombination and segregation of characters which ordinarily are expected rarely occurs. In-

stead the second generation usually has the appearance and characters of *S. demissum,* the female parent of the first cross.

Obviously, some other method must be employed if any progress is to be made. This has been accomplished wherever work of this nature is in progress, by means of backcrossing. Instead of selfing first-generation hybrids, pollen of a domestic variety is applied to the stigmas. It is decidedly preferable to use pollen of some variety other than the one used in the first cross. Use of the same variety twice in succession is very likely to result in dwarfing. There are, of course, a great many exceptions. During the past 15 years the writer has grown thousands of first backcross plants. About 12 or 13 per cent of them proved to be susceptible to blight and were discarded. The others when grown in the field gave indications that segregations had occurred. Thus far 2 individuals have been found which could have been introduced as commercial varieties if their culinary qualities had been satisfactory. All of the others had some or several objectionable characters which precluded their use. The most common objections have been,— long stolons, extreme lateness, small tubers and deep eyes.

If one selects some of the more satisfactory backcrosses and backcrosses again to a domestic variety, a progeny is obtained, with more failures than successes, of which about one-third are susceptible. The plants which do not blight, when grown in the field, have the gross appearance of a field of commercial potatoes. Plants can be found which are mature before the autumnal equinox, and which bear 2, 3, or even 4 pounds of tubers of commercial size. Several thousand selections of plants in this stage have been made and tested. At the present time not one of them has been retained. They have been rejected for various reasons but perhaps the commonest cause of rejection has been deep eyes or irregular contour.

Since a high proportion of the plants in the second backcross still carry the gene for immunity, a third backcrossing has been tried. About one-half of the progeny continues to give immune reaction by inoculation and in this generation many more desirable types can be found and tests of these, which are now in progress, indicate that suitable types have been isolated which have enough of the desirable horticultural characteristics to make them satisfactory commercial varieties. Limited regional tests already show that some selections which seem to be entirely satisfactory at Ithaca are unsuitable on Long Island, in Northern New York, in the central plateau region, or on the dry hill lands of Western New York. It also appears very likely that selections which were dropped on the basis of behavior at Ithaca might have proved satisfactory if

they had been given a chance in some other environment. It is too early to say whether it is going to be necessary to begin regional testing immediately after the selection of single plants or whether certain of the selections are sufficiently adaptable to be grown in the several potato regions of the state or of the blight zone.

The program as outlined above has several unfortunate features. In the first place one is limited in the selection of sires and secondly the "get" of these sires is usually insufficiently known. A seedling obtained from F. A. Krantz under the number 11-5-9 is especially good for seed production but its "get" is unusually bad for tuber color and tuber contour. On the other hand, Krantz' 41-2-10-1 has proved particularly useful because it carries drought tolerance, and passivity to the mosaic caused by virus X as well as good tuber characters. As a sire, it equals or surpasses Katahdin in most respects. Krantz' more recent 15-2, a most unlikely-appearing plant as grown at Ithaca, is the best sire so far tested in that it gives a high proportion of sets with an abundance of seed, introduces earliness, yields a higher than average proportion of well-shaped tubers and also yields a most gratifying number of plants, the tubers of which are mealy when cooked. Earlaine has been avoided until recently but limited experience indicates that it not only introduces much desired earliness but that it also "gets" an unexpected number of offspring with mealiness. Another plant which also appears to be particularly good as sire is U. S. D. A. seedling 47,258. Hindenburg and Jubel are useful for introducing scab resistance but they have little else to commend them. Imperia with its high resistance to leaf roll is a very uncertain seed producer and its offspring have a preponderance of plants with tubers that have a waxy consistency when cooked.

It would appear most desirable to introduce some of the standard varieties into the program but in most instances this can be done only by employing them as female parents. Any hybrid in the second backcross stage which sets seeds naturally in the field is reasonably likely to give a set of seeds on the standard varieties. It is to be expected that a third backcross secured in this way would yield a higher proportion of offspring with desirable growth and tuber characters than would a third backcross in which the male parent is a seedling or variety of unknown breeding qualities. It is not to be expected that this procedure would lessen the number of immune offspring obtained although present indications are that it does. In this program Green Mountain, Adirondack (Red McClure) and Russet Burbank have been disappointing, whereas Rural New Yorker, Russet Rural and Triumph have yielded most gratifying results.

In all of this work the seedling plants are inoculated soon after emergence from the ground and every selection that is made thereafter is sampled and inoculated at least once each year as long as it is retained. This is done in the greenhouse where ideal conditions can be maintained. The years 1918, 1928, 1938 and 1942 are the only ones in which field conditions have equalled the conditions constantly obtainable in the inoculation chamber. In many of the intervening years no blight appeared spontaneously in the field and some early attempts to introduce the disease in test plots met with only partial success.

The whole success of a program of breeding for blight resistance depends upon a positive elimination of all plants which react in the slightest degree to the parasite. When a series of hybrids is inoculated, it has been found that in addition to the plants which blight unmistakably and those which show no trace of infection, there are also usually some plants which stand in an intermediate position,—a few dry spots on an unfolding leaf or stem tip, or perhaps only a few "specks." Such plants, if placed in a chamber of saturated air for 12 hours, may show sporulation of the parasite and can be rejected. At one time or another practically every one who has had experience with this situation has decided that since the organism is unable to sporulate, the plant showing the small lesion may be placed in the class of immunes. Unfortunately, it has been found that by special manipulation, involving principally patience and frequent microscopic examination, a few spores can be obtained from such lesions. If these spores are germinated and applied again to the same plant, a larger lesion is produced and new spores are produced more readily than in the first case. By repeating this process for about 3 passages through the resistant plant, the parasite builds up its power of attack (virulence) so that the potato plant which has remained practically constant in its resistance, is now blighted as severely as though it never had had any resistance. More unfortunately, once the parasite has developed this virulence it holds on to it for many generations even though it is passed only through varieties which are susceptible to the weaker form. Once this virulent strain has been established it is found that it can extend itself to take down some of the seedlings which formerly had been placed in the class of immunes. This has been accomplished experimentally and in 1938 and in 1942 it occurred naturally in field plots. At the present time there remain a considerable number of hybrids on which blight never has been induced. It appears, however, that by selecting the proper series of hybrids from the new crosses, it might be possible to continue the build up of virulence of the parasite to the point where it would infect the original blight-

immune parent. To meet such a condition, the line of attack appears to be that of employing for inoculation a built-up strain of the parasite several steps more virulent than the strain universally present in our fields. By knocking out the intermediate steps, *i. e.*, by destroying the plants which spot or speck, it should be possible to develop a class of plants which would be immune under all field conditions. This line of attack, of course, is predicated on the assumption that the parasite as it occurs in nature exists at approximately the same level of virulence and also upon the assumption that new varieties will not be introduced from at home or abroad which could act as intermediates in the process of building up virulence. The first assumption can be verified by gathering samples of the parasite from many localities and testing for virulence. This has been done in a limited way without any indication that the several samples differ in respect of virulence. A more satisfactory method of verifying the assumption perhaps can be made by sending the immune plants to a great number of localities and observing results. Such tests are in progress and to date the assumption is valid.

The other assumption, namely that varieties of intermediate resistance will be introduced which will serve as steps in building up virulence, probably will prove to be valid, too. At any rate four U. S. D. A. seedlings, 528/118, 582/230, 528/242 and 627/49, exhibited considerable resistance to blight in one plot in 1942, and all four are receiving serious consideration as varieties worthy of introduction because of resistance to common scab. At the present time steps are being taken to determine their relation to the program of developing blight-immune varieties.

In view of the fact that repeated backcrossing is the only known method of developing satisfactory varieties that are blight-immune, it seems logical that the use of scab-resistant varieties in the backcrossing should make it possible to combine scab resistance and blight immunity in the same plant. This has been attempted and present indications are that the combination can be effected satisfactorily. Needless to say this is no solution of the problem mentioned in the preceding paragraph because the scab-resisting seedlings have been tested extensively and are on the verge of increase for general introduction, whereas the seedlings combining scab resistance and blight immunity are only now in the process of testing. It must be remembered here that after the level of virulence of the blight organism has been raised it continues at the new level for at least 20 generations, and so far as later introductions of blight-proof varieties are concerned they will probably need to be raised another step higher than has seemed necessary to the present time.

It is known that the immunity of aerial parts does not necessarily extend to the tubers. Tuber rot has been found repeatedly under plants that were entirely free from foliage infection. The source of the infection has been adjacent infected plants the foliage of which was intermingled with that of the immunes. This condition has been known to exist for several years but work has gone forward on the assumption that, from the practical standpoint, the immunity of foliage would preclude the occurrence of tuber rot under the conditions of commercial culture of the potato.

Summary

The foregoing essay is essentially an orientation of published facts presented in a fashion designed to give an overall picture of the blight-immunity situation as it exists at the present time. Those places where speculation or indications are introduced are the places where more intensive work is called for. It is to be hoped that more persons will become interested in the general problem of overcoming permanently this century-old menace to potato production and that this statement will be of help to them in overcoming or avoiding some of the dfficulties involved.

SECTIONAL NOTES

ALABAMA

The South Alabama potato crop began moving to markets the first week of May. Weather conditions, in general, have been favorable to a good quality potato. The rainfall in April was somewhat low, and yields probably will be reduced 10 to 20 per cent as a result.

Plans for relieving the labor shortage, made very acute by the heavy demand for labor in the Mobile shipyards, have been completed. About 500 high school boys from nearly 20 or more city schools in the state have been recruited by the Alabama Extension Service for work in the Baldwin County section for the six-weeks shipping season. The boys are to sleep in temporary quarters provided by the state with the health and safety of the boys in the hands of the state and county officials.

A total shipment of 5,000 to 6,000 cars is expected. Approximately 75 per cent of the crop consists of Triumphs with the balance largely representing White Rose.

Growers find it difficult to understand why prices to them are limit-

ed to about two and one-half cents per pound, while in Mobile, just across the Bay and in view of the potato fields, retail prices are eight to ten cents per pound. (May 22).—L. M. WARE.

CALIFORNIA

There has never been a Potato Deal like the present one in Kern County.

A large percentage of the acreage has been purchased at prices ranging from $150.00 to $500.00 per acre, in the fields.

The farmer harvests the potatoes but does not grade, haul or wash them, which takes the transaction out of O.P.A. regulations.

Recently there has also been considerable purchasing done at ceiling prices. As a result, the independent buyers are unable to obtain supplies through the usual method of day-to-day buying.

The second complication is the truck situation. A large volume of potatoes moved via truck during the early part of the Deal. The truck rates that were charged were considerably in excess of those of last season. The O.P.A. has since ordered all truck rates rolled back and, as a consequence, the great majority of the truckers have quit, claiming that on account of increased labor cost, etc., they are unable to function at these rates.

A third complication is the heavy government purchasing which is reported to be one-third of the daily loadings.

Generally speaking, the quality and yields are proving very satisfactory.

The demand coming from all over the country is truly colossal.

The present ceiling prices on U. S. No. 1 potatoes are $2.45—this price will be reduced to $2.20 on the 1st of June. (May 7).—E. MARX.

About the middle of March, it was reported that an Eastern concern was dealing through local representatives, and purchasing fields of potatoes on a per acre basis. Early sales in the early section, where generally speaking yields are lighter, were purchased for a price as low as $165.00 per acre "on top of the ground," meaning that the grower supplied the tractor, the digger, and two men to operate this equipment, with the Eastern concern furnishing the sacks and all pick-up labor in the field. By the 1st of April it was reported that approximately 5,000 acres in early section had been purchased on such a basis with prices ranging from $165.00 per acre to approximately $300.00 per acre. This same general policy or plan is still functioning, and one of the recent

sales was a 1,050-acre holding which was sold for $500,000 "on top of the ground." The total number of acres purchased on this basis is not known, but each day additional acres are purchased. At the present time it has been indicated by various individuals that 80 per cent of the potatoes being harvested at present are now owned by some corporation that has purchased the potatoes in the field. At a meeting of growers this week, this method of marketing potatoes was discussed and the following points were brought out by the growers. (1) The grower under this method of marketing was losing all contact with the trade, buyers, and the market. (2) Should some conditions arise, whereby the potatoes would not be sold in the field, the grower would have lost all trade relationships. (3) Small cash buyers which have aided in making this market a cash f. o. b. market, would not be available to aid in marketing the crop. (4) With the shortage of labor the grower feels that he is eliminating his problem, as possible loss of his crop would be due to a shortage of labor. (5) Generally speaking, if the grower had kept the potatoes and marketed them under normal or former methods, he would have realized in most cases, considerably more money per acre.

From all indications, the yield per acre this year will exceed that of any other year. We have, however, found some blight in the early section that has reduced the yield, but because of our dry weather conditions, we do not anticipate blight trouble in the later potatoes. (May 7).—M. A. LINDSAY.

COLORADO

The Colorado potato deal cleaned up at least a month earlier than normal because of the price ceilings which reached a peak of $2.30 for April and dropped to $2.20 for May with another drop in June. A recent ruling raised the ceiling to $2.40 for May and June but the potatoes are gone. A large part of the dwindling supply went to the Army during April. Colorado will probably not have any new potatoes until the 1st of July.

A 17 per cent increase in acreage is indicated for 1943. A water shortage was in prospect for the San Luis Valley, but a recent rain and a snow storm have somewhat relieved the situation at least temporarily.

Colorado growers will plant more certified seed than ever before in history and better seed, in general, is being planted than ever before. Ring-Rot, which threatened the very existence of the potato industry in 1938 is practically non-existent. With favorable weather, Colorado should have one of the largest crops in history.

Plantings in the earlier districts have been completed and will soon

be in full swing in the San Luis Valley and Western Slope areas. Northern Colorado does not plant its main crop until June. (May 13.)—C. H. METZGER.

IDAHO

Activities in Idaho are at a low point with practically all the old potatoes shipped or being held for dehydration, and preparations for the main planting will be under way after the middle of May.

Inquiries for seed are still coming in from both outside and inside the state, and there seems to be little change in the prospect for a large increase in table stock acreage compared with last year. Irrigation water prospects for the season are excellent.

Dehydration is again receiving more attention with at least five more dehydrators being considered. Idaho now has six dehydrators and three starch plants in operation.

Black market activities from the standpoint of seed potatoes being sold for table stock has probably not been of great importance in Idaho, and ceiling prices on seed came too late to effect materially the transactions in seed.

Pennsylvania's wild life claims should not go unchallenged. In Idaho last year, the writer stood in one seed field examining tracks of both deer and moose, while the county agent and the seed grower planned a bear hunt to start in one corner of the field. One potato grower reports "getting his elk" in his own pig pen. (May 12).—EUGENE W. WHITEMAN.

INDIANA

The potato situation in Indiana is just about the same as it is everywhere else. Some of our growers have taken advantage of the condition and also the disposers of seed have rooked a few of the buyers and a few of the purchasers, and at the present time there seems to be a lot of seed on hand. Late certified seed from various localities is selling at $4.00 to $6.50 per hundred pound sack. The seed is apparently very good and this is the first time I have ever noticed so many old second-hand sacks on the market. Of course, we can readily see why this is.

Naturally, when people get a little excited they do things a little bit differently and some people this year have said, "Well, hang the cost, let's put out the potatoes." In our state the acreage is larger than ever before. Most of this, however, will be on the small farm potato patch scale and yet I have had several people write to me inquiring where they could buy as much as one or two carloads of good certified seed.

The Irish Cobbler, Katahdin and the Chippewa are the main varieties for planting in Indiana.

Some of the early potatoes were nipped by frosts but there was no serious damage and the main crop will be going in almost any time now until the latter part of this month. Our spring conditions have been most ideal and the planting has not been delayed for any reason.

We have also found considerable damage to the newly sprouted potatoes and some of the other crops from the potato flea beetle, which is present in larger quantities than ever before. Some growers are putting on a dust or spray even though the plants are only two or three inches tall. (May 8).—W. B. WARD.

LONG ISLAND

Long Island has the largest acreage of potatoes in its history. Potato men agree that there is a 20 per cent increase compared with 1942, which was the largest to that time.

The larger part of the acreage was planted early, with the ground in good condition. The cold, unfavorable weather delayed the planting of 20 per cent of the crop. Continued cold weather has retarded the germination. The crop is at least ten days later than normal.

There is some complaint that the seed pieces are starting uneven. Even with the increased plantings, it is doubtful if Long Island markets as many potatoes as in 1942, which was the largest crop ever harvested. (May 14).—HENRY R. TALMAGE.

LOUISIANA

The Irish potato yields in Louisiana have been materially cut and will be much lower than first anticipated because of a drought which is existing at this time. The entire season has been spotted,—first with an early freeze which cut back plants, lack of nitrogen in fertilizer which caused early yellowing of the plants, and during the month of March the heaviest rains we have experienced for 23 years, and a drought at this time which is causing early maturity, smaller potatoes, and smaller yields. All our potatoes are being sold close to ceiling prices. Labor in harvesting potatoes is being done in many cases by school children—both boys and girls. The potato digging season for south Louisiana started out in an intensive way about the 2d of May, small lots having been harvested since the 21st of April. Potatoes are moving by trucks and railroad. We are shipping, so far, most of our potatoes on a Victory grade basis which includes No. 2's, 1½-inch minimum size and up. It is really a combination grade of No. 1's and No. 2's. (May 7).—A. C. MOREAU.

MICHIGAN

The potato situation in Michigan has never been so acute. Seed normal acreage. Growers, who find themselves short of seed, are travel-shipments are about completed with hardly enough seed left to plant a ing the country picking up a few bags here and there, paying anything above ceiling prices.

The black market has forced legitimate established dealers out of the deal. Black market operators are very active, mostly hauling by truck. They pay cash so that no records are available. There is no doubt that a lot of good seed that should be planted has actually been eaten up. It is not uncommon to see retail stores bare of table stock potatoes and see stock marked Seed Potatoes "Not to Be Used for Human Consumption." When this condition exists, what is the average customer going to do? This is not difficult to answer. They simply are having their stocks marked "seed" and eating it.

There is considerable uncertainty regarding the acreage that will actually be planted this year. Growers are confused with the government program. Incentive payment, price ceiling, floor price, and now the O.P.A. statement that would lead one to believe that farm prices will be lowered. This, combined with a labor shortage, leaves growers in a frame of mind that potato growing has passed from a business, and not too easy a business, to a patriotic food producer whose own judgment tells him that with high seed prices, fertilizer, labor cost, low labor efficiency, lack of material and equipment, is making him the biggest gambler in the country today. (May 12).—H. A. REILEY.

NEBRASKA

The acreage intended to be planted this season, according to present reports, will be short of that asked by Government planting agencies. In fact, it appears that there will be a slight shrinkage compared with last year's acreage. In the case of potatoes being entered for certification, present indications are for the same, or a slight increase above that of 1942. In view of the fact that the certified acreage has been shrinking for two seasons previously, the halting of the tendency to reduce certified acreage is a good indication.

The labor situation, as it affects agriculture in general, is still rather short. There is more call for farm laborers to work throughout the year than can be supplied. The seasonal demands will commence with the planting of potatoes (about June 10) and will increase as the general

harvest approaches. The plans to relieve this include importation of Japanese Nationals, and surplus farm labor from territories in eastern Nebraska and the Ozark region. A few have already been brought into the territory. There is also a possibility of using prisoners of war.

The black market has ceased to exist, primarily because there is very little movement of potatoes in this territory. A great deal of thought is being given to preventing the situation from recurring in another season. (May 12).—MARX KOEHNHE.

NEW JERSEY

Most of the commercial potato growers completed their planting by the 8th of May. This is a week or two later than the usual date and may result in a slightly later harvesting date but should not affect total yields appreciably. Many of the early plantings are now up and some growers have completed their first cultivation. Good stands have been reported. The recent rains during the 13th and 14th of May should give the crop a good start.

Total sales of seed and fertilizer and reports of farmers intentions to plant indicate that the acreage planted is approximately 25 per cent above the 1942 acreage.

A strong black market still exists in the potato deal. Retailers are paying as much as $4.50 per 100 lbs. for second size and $7.00 to $10.00 for U. S. No. 1's. Most black market transactions are on a cash basis, the retailers buy at the ceiling price and are billed for additional produce which they never receive. Retailers are charging from 7 to 13 cents a pound for poor quality stock. Many local markets have been without potatoes for two weeks and sales are limited to 2 or 3 pounds per customer when supplies are available. It is hoped that offerings of new potatoes from the south will ease the situation soon. (May 15). —J. C. CAMPBELL.

NEW YORK

In common with most of the rest of the United States, seasonal weather conditions are such as to delay planting in New York. Not even oats and cannery peas have been planted in most areas at this date, (May 15) on account of the excessive rains. This will probably retard potato planting except on Long Island where the crop was planted on time about a month ago. It is apparent that the New York acreage will be increased at least 15 per cent upstate and that it has been increased at least 10 per cent on Long Island. It is not expected that supplies of either seed or fertilizer will curtail commercial plantings. The demand

for seed by new growers and Victory Gardeners has been far in excess of supplies.

Because of the losses caused by late blight last year, interest in spraying equipment for the 1943 acreage has been active since last fall In addition to existing equipment, plans are now definitely taking shape to provide tractor mounted sprayers for 18 custom spray rings in eight counties. At the moment, the principal bottlenecks appear to be a possible shortage of potato diggers on Long Island, and labor to handle the crop at digging time.

Long Island usually plants about 25 per cent of the total New York acreage and harvests about one-third of the total production. This year Suffolk County has planted nearly 50,000 acres, and Nassau County probably 10,000. About the 11th of May, H. R. Talmage and Son of Riverhead, Long Island, submit the following report for Suffolk County: "The potato acreage in Suffolk County has taken a big jump this year. As you ride around the country there is nothing green in sight: scarcely any land being saved for grain or cauliflower.

"Potatoes were planted under miserable conditions. The weather was much colder and more windy than any season on record. But the weather was not such as to actually stop operations and the date of planting was not much later than usual. It has continued cold since that time and the potatoes are not yet coming through the ground, while it is common to be able to "row" them by this time and start cultivating. They will be at least a week later than normal. At this writing it is very dry here. In digging around, it appears that emergence will be very uneven and there will be a considerable number of weak sprouts.

"Fertilizer and seed supplies were adequate, I believe, and we were able to get labor to take care of planting. Small allotments of machinery may prove a limiting factor in getting work done. Diggers in particular are very short. What the harvest labor supply will be we do not know, but we are hoping for the best." (May 14).—E. V. HARDENBURG.

NORTH CAROLINA

I have just returned from the eastern part of the state after visiting areas north and south of Albemarle Sound. There is considerable variation between and within these two sections.

North of the sound, stands are fair to good but many bad spots occur where seed pieces decayed because of the heavy rains early in the season, and also the cold weather. A large percentage of the fields was killed in mid-April but a few later plantings escaped. On one protected

site, near the Pasquotank River, no injury had occurred and plants were setting tubers—some almost in Number One grade. This section, generally, was not hurt by the dry weather in May.

South of the sound, practically all plants were killed in early April and again in mid-April. This has caused excessive sprouting and will not only delay harvest but will also reduce yields. This section was very dry during the early part of May but the rainy period during the week of the 9th of May has been most favorable for the growth of the crop. With continued seasonable weather, harvesting may begin by the 15th of June.

The labor situation is unchanged and is more acute in the Elizabeth City-Camden area than in the Aurora and other sections south of the sound. Labor camps have already been established and the growers are hoping that sufficient help will be available to harvest the crop. (May 14).—M. E. GARDNER.

OHIO

Rains have delayed early potato planting in the northern one-half of the state, but the early planting along Ohio river bottoms has been completed. Late potato planting will start as soon as the soil is in good condition. Many growers will plant earlier than usual to speed maturity and enable them to use school help in harvesting.

More than one-half of the total crop will be planted with early-maturing varieties. The Katahdin and Sebago will replace much of the acreage formerly planted to Russet Rurals.

Few potatoes are now available to civilians. One large chain in Columbus was without potatoes for four weeks. Most of the potatoes on the market are now coming from California. Black markets continue to flourish regardless of any efforts to check them on the part of O. P. A.

Most Ohio growers sold their potatoes in the fall as ceiling prices did not justify holding. Ohio growers cannot store potatoes from fall to spring for 20 cents per cwt. (May 14).—E. B. TUSSING.

OREGON

Practically all the potatoes are shipped from this area. The Klamath district shipped 7,400 cars for the season by the end of April. Seed is scarce and high priced. The acreage for the district for 1943 seems to be about 23,000. Approximately 1,500 acres of this will be on U. S. Bureau of Reclamation leased lands, opened for potato growing this

year for the first time. Applications for seed certification are a little above normal. More certified Russets than usual have been shipped in from other districts for foundation stock.

Prices have been at ceiling throughout the major part of the season. It has been rumored that black markets prevail in the south. The labor situation is at this date a little better than that of last year. Apparently ex-farm boys are turning to farming from less essential occupations. Also, more consideration for agricultural workers is being given by draft boards.

Machinery and trucks are hardly sufficient for the heavy acreage this year, but we hope for additional machinery. Planting started the last week in April and now, the 10th of May, it has reached heavy proportions. (May 10).—C. A. HENDERSON.

PENNSYLVANIA

Potato planting operations in Pennsylvania are progressing satisfactorily, although they are somewhat behind schedule. Rains during April held up all fitting and planting operations. Growers who had seed in the ground during this wet period expected some losses because of rot. Recent examinations revealed very little rotting except in low areas where the drainage was poor.

In Potter County thirteen rubber-tired tractors were recently paraded through Coudersport to stimulate the potato production program. It was reported that these tractors were the first ones released by the War Board that were rubber-mounted. These tractors will have spray tanks mounted on them and will be used in spray-rings already organized. It took a great deal of foresight, patience and energy to get these rubber-mounted tractors released, but with the leadership of the County Agent, Bert Straw of Potter County, and the active support of several potato growers, the impossible was accomplished. Their release was secured through the State War Board of the United States Department of Agriculture. These tractors are not something that have been promised for the future. They are already in the hands of the farmers and are now being used to increase the potato acreage in Pennsylvania, and Potter County in particular.

Recent estimates of the Federal State Crop Reporting Service indicate an increase of nearly 10 per cent in the acreage of potatoes to be planted in Pennsylvania during 1943, compared with 167,000 acres planted in 1942. (May 14).—K. W. LAUER.

"Potato planting in Pennsylvania is from two to three weeks late this year principally because of the cold wet spring. Farmers are now planting and a considerably larger acreage than was planted last year now seems certain. Increases in acreage have been mainly on small farms without adequate spraying machinery. The increase in commercial type spray rings that has been giving these small growers good disease protection has been in part, inhibited by a scarcity of machinery. However, some twenty new spray rings capable of spraying 4000 additional acres have been able to secure equipment and will be in operation this next year,

Labor is scarce but most of the larger growers have been able to secure enough help to plant and grow their crop but will necessarily have to use women, high school students and children in the harvesting operation. Their outlook is better than newspaper articles would lead us to believe.

The seed situation has been exceptionally bad. The fact that ceiling prices allowed a premium on potatoes labeled as seed has prompted the selling of much of the potato stock grown in the state as seed. In addition the market has been flooded with so called "selected seed" or just "potato seed" from out-of-state sources. A number of those entering the potato growing industry for the first time have not realized that this stock is poor seed or totally unfit for seed and have planted their acreages with it. Such a situation certainly needs clarification before another year's planting operations begin. (May 7).—O. D. BURKE.

SOUTH CAROLINA

A late freeze on the 14th of April killed the potatoes to the ground for the third consecutive time in some portions of this area. Such potatoes are in very bad condition and will hardly produce enough to pay for the seed potatoes used to plant the crop. That is reason enough for the growers to complain about the price ceiling.

The potato crop is in need of rain and yields will be low unless the rain comes soon. Our harvesting period will start about the 24th of May, which is about 10 days later than usual. (May 13).—C. N. CLAYTON.

VERMONT

For the first time in modern times Vermont was apparently clean of potatoes by the last of April. The only exception was in stocks held

back by growers for seed or for delivery on sales made at an earlier date. Shipments of seed are now coming in (May 13th) under War Board authorization from Maine. Most, if not all of these seeds are "selected seed." Practically all Vermont certified seed was sold out by the end of March, and very little table stock remained. A survey of stores in Montpelier and Barre, small cities in the center of one of Vermont's best agricultural regions, shows no table stock potatoes whatever for sale. A similar condition has been reported generally.

It is believed that the state's planting acreage will be stepped up from 12,000 as of last year to at least 16,000 this year, though dubious quality of much "selected seed" being used may not provide a corresponding increase in production.

Ring rot has been found in some lots, though only a few casual inspections have been made.

Cold wet weather extending from spring to date has retarded planting preparations and very little seed will be planted before the last two weeks in May.

It is not believed that any Vermont certified seed went into the black market. But the ceiling schedule based on sales between the 15th of February and the 1st of March had little effect because extremely few growers made sales at that time.

Vermont added its official protest, through the Governor and Commissioner of Agriculture, against the recognition of "selected seed," under prevailing conditions, by O.P.A. (May 13).—H. L. Bailey.

VIRGINIA

Perhaps of greatest interest to the white potato growers at this time is the question of what the Office of Price Administration will do in connection with ceiling prices.

On last Thursday, representatives of the farm organizations met with the Office of Price Administration, Mr. Tapp, and Mr. Meal of the United States Department of Agriculture. The potato situation as well as that of other vegetables, was discussed, but no decisions were announced.

On the afternoon of May 21, there is to be a meeting of the North Carolina Produce Growers Association at Raleigh, North Carolina, at which time Mr. A. E. Mercker and some one from the Office of Price Administration, will discuss the potato situation. I would assume that by that time there will be definite commitments from the Office of Price Administration. The potato growers from New England to Florida

have worked very diligently on a program which would give the producers a small margin of profit under normal production conditions. It can be said that the growers have made every effort to set up a favorable situation for consumer and the trade as well as for themselves. We firmly believe that unless these reasonable recommendations are heeded, best results will not be obtained.

In meetings it has been mentioned to the Office of Price Administration that it cannot protect the consumer without protecting the producer. That idea is based on the following thoughts:

1. That ceiling prices, if placed, are unworkable unless they are somewhat in line with supply and demand requirements.

2. That ample supply is the only way to maintain reasonable retail prices.

3. That supply can only be maintained and increased by means which will afford the producer an opportunity for profit.

These ideas are interlocking and to our mind reach the above mentioned thought, "that the producer has to have protection in order to give the consumer the protection the Office of Price Administration is striving for." If there is some way that the Office of Price Administration could establish some principles like the above, if they are principles, it might facilitate the development of workable programs in a shorter time, and avoid so much of the trial and error procedure that has been in effect.

The acreage of white potatoes on the Eastern Shore of Virginia possibly may be 10 per cent larger than it was last year. The appearance of the crop is the best that it has been for many years. Recent rainfall has been ample and the current indications are for a good crop, with harvesting possibly a little later than normal.

Since the above notes were written, the following information has been received and acted on as described:

Two potato price control programs are said to be before Mr. Byrnes. Both are said to provide a reduction in the income received by the trade through current markups. However, one provides that the saving be used to reduce consumer costs and the other to pass this saving to the producer and raise his price to more equitable levels. The proposed ceilings in the Southeast are below cost of production and point of origin marketing costs. Growers in southeastern states are asking their Congressmen to petition Mr. Byrnes to adopt a plan passing the savings to farmers. Virginia, North Carolina and Maryland growers are asking that the farmers' point-of-origin price be not less than $3.25 per

100 pounds. Possibly other southern states may ask for more on account of short crop. (May 17).—G. S. Ralston.

CANADA

Two important changes have been made in the regulations that govern the production of certified seed potatoes in Canada. An additional grade has been established, and a new regulation has been made that will be effective in 1944.

New Grade

The new grade will be intermediate between the present "Foundation Seed" and "Certified Seed" grades, and will be called "Foundation A". This becomes effective immediately, and the 1943 crop will be certified under three grades: "Certified" seed (for the production of table stock only), "Foundation A" seed, and "Foundation" seed.

New Regulation

The new regulation, which will become effective next year, reads:

"All fields entered for certification in 1944 must be planted with either 'Foundation' seed or 'Foundation A' seed."

Purpose of New Regulation

Our experience for many years has proved that the planting of high quality seed—seed either of Foundation or near Foundation standards—is essential for the successful production of high quality seed potatoes. Growers whose certified seed stocks are "marginal," that is, whose fields passed inspection, but contained the maximum or nearly the maximum of disease allowed by the standards, have, for a long time past, been advised to obtain new seed stocks of Foundation or near Foundation standards for the future production of certified seed potatoes; but many growers have continued to plant marginal seed, to the disappointment of themselves and the growers who buy their seed stocks.

From 1944 onwards all growers will be required to plant high quality seed.

Field Standards

Foundation and Certified Seed

The standards for these two grades have not been changed.

Foundation A

(a) If field or plot is planted in tuber units:

1st and 2d Field Inspections—Tolerance for any one virus disease not to exceed 5%

Total virus diseases not to exceed 1%

Individual tolerances for other diseases shall be the same as for "Certified Seed," except that the total for All Diseases shall be:

3% at 1st Inspection, and
2% at 2d Inspection.

(b) if not planted in tuber units:

The tolerances shall be those allowed under the present Foundation standards, namely:

1st Field Inspection, Total Diseases.......................... 5%
2d Field $nspection, Total Diseases 1%

"Foundation A" tags shall not be issued for small size seed—1½ to 3 ounces. Small size seed produced in "Foundation A" fields, however, shall be eligible for "Certified Seed" tags.

"Foundation A" tags shall not be issued for seed potatoes produced in any field or plot in which aphids or other insects are sufficiently in evidence to warrant suspicion that diseases may have been introduced or spread thereby. (Apr. 8).—E. W. Harbor.

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COPPER SPRAY SUBSTITUTES[1,2]

ALBERT E. DIMOND[3]
Department of Botany, University of Nebraska, Lincoln, Nebr.

J. W. HEUBERGER[4]

AND

JAMES G. HORSFALL[5]
Connecticut Agricultural Experiment Station, New Haven, Conn.

The search for new spray materials has gained impetus during the past year and a half because of the fact that copper and mercury have "gone to war". A shortage of mercury compounds has already developed, and while copper is still available for use in fungicides, it is expected to become scarcer as the war goes on. In contrast, more food, especially potatoes, must be produced than ever before.

Disease control practices, therefore, must become more effective. With a scarcity of copper sprays we can turn, in part at least, to alternate spray materials, containing little or no copper.

Very few materials have been tested on potatoes chiefly because Bordeaux mixture has worked so well in the past and it is so inexpensive that substitutes have seemed unnecessary. Nevertheless, with the current need and demand for substitutes, the editor has requested his brief summary of present knowledge. It has been prepared on the

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[2]All original experiments reported were conducted by the authors at the Connecticut Agricultural Experiment Station, New Haven, through collaboration of the Crop Protection Institute and the Connecticut Agricultural Experiment Station.

[3]Until September, 1942, Fellow, Crop Protection Institute.

[4]Until November, 1942, Plant Pathologist, Crop Protection Institute.

[5]Chief, Department of Plant Pathology and Botany.

basis of the authors' general experience with new organic materials extending back to 1938, and it will cover crops other than potatoes. The emphasis will be placed on disease control, although copper, of course, has marked insecticidal properties on potatoes as well.

Organic Substitutes for Copper

1. *Tetrachlorquinone or Chloranil (Spergon).* One of the newest and most promising materials is tetrachlorquinone, developed by Crop Protection Institute, and introduced in 1940 (4, 16). Thanks to a wide program of advertising, this material is already well-known. It is produced in several grades: standard (99 per cent active), wettable, and in various dilutions on talc.

a. *Seed protection.* Its value as a seed protectant on legumes is at present well-known. On peas (9, 24, 25, 29, 30), lima beans (4, 16), soybean and vetch (6), it has been used with success, giving not only good protection against pre- and post-emergence damping-off organisms, but also an apparent stimulation to growth of the plant. McNew (25) has shown the stimulative effect to exist in the absence of damping-off organisms, indicating that tetrachlorquinone has direct stimulatory action on the growth of the pea plant.

Tetrachlorquinone appears useful as a seed protectant for cotton (9, 28), for small grains against smut (21), and for sorghum against smut (20, 22, 23), and Livingston has reported some improvement in emergence over checks when spinach seed were treated (23).

The results of some preliminary tests on sweet potatoes, using aqueous suspensions of the wettable grade of Spergon as a seed potato and sprout dip treatment have been reported (3, 5, 8, 36). Elmer (8) records increased sprouting from dipping the seed potatoes and good control of stem rot from sprout treatments, whereas Daines (5) reports only fair control of scurf when the sprouts are dipped in this material. Cook and Harter (3), in their work with black rot obtained abundant growth of the black rot organism on sweet potato cubes, dipped in a suspension of infected tissues before dip treatment with the fungicide.

When applied to white potatoes, the possibilities for treatment as a surface-sterilizing agent of seed pieces are obvious. Our own investigations have indicated that tetrachlorquinone is sufficiently soluble in water to be toxic to fungous spores. This toxic action is accelerated markedly when the suspension of fungicide is heated at temperatures well below those which would cause injury to tubers through heat alone (40° to 45° C.) (7), and it is possible that heated suspensions might penetrate beneath the superficial layer of cells of tuber pieces.

b. As a *foliage spray*, tetrachlorquinone has not been extensively tested. Against apple scab, it has been successful, its performance having been published in 1940 under the code number 120 (33), prior to its commercial release and announcement of its chemical composition. On McIntosh apples, it has given commercial control of apple scab and fair control of black rot. On apple trees of the Wealthy variety commercial control of cedar apple rust was obtained. In all of these tests, the material was applied at the rate of 2 lbs. of the standard (99 per cent active) unwettable grade per 100 gals. Before adding to the tank, it was pasted with casein glue.

Foliage injury to McIntosh trees was slight and took the form of localized chlorotic spots. Injury did not appear to affect the size or number of fruit harvested and did not cause a dropping of fruit.

Tetrachlorquinone does not appear to be suitable as a spray on celery, because the control of *Septoria* blight obtained under Connecticut conditions was far inferior to that given by Bordeaux mixture and there was some foliage injury.

Such serious injury was obtained when tetrachlorquinone was applied to roses, that it was necessary to abandon spray treatments for the control of black spot. However, it has proven useful in the control of diseases of less sensitive ornamentals under greenhouse conditions, for Stoddard and Heuberger (34) have controlled carnation rust by spray treatment with this material.

In our 1940 tests, very interesting results were obtained when tetrachlorquinone was applied to tomatoes for the control of *Alternaria* blight. The standard grade was applied at a strength of 2 lbs. per 100 gals., and before addition to the spray tank was pasted with casein glue. Bordeaux (8-8-100) and tribasic copper sulfate (3.7 lbs. per 100 gals.) were also applied. A small power sprayer was used and plots consisted of 20 plants each, and were replicated four times at random. Plants were rated for disease control by the method described by Horsfall and Heuberger (17). Defoliation of tomato plants was the index of disease development employed. Rating plants on this basis, we observed that sprays containing copper were most effective in disease control (table 1).

Summary tables of yield records are presented, which indicate a "stimulative" action of tetrachlorquinone. Plots to which tetrachlorquinone were applied yielded a significantly greater weight of fruit than check plots. No other spray treatment gave significantly higher yield values than check plots (table 1).

The data in table 2 are also a measure of disease control, since

TABLE 1.—*Weight of healthy fruit harvested from tomato plots sprayed with various fungicides*

Treatment	Dosage (Pounds per 100 Gals.)	Per cent Disease Control	Average Weight per Plot of Fruit Harvested (Ounces)	Difference in Yield from Check Plot	Significant Difference (P = 0.05)
Spergon	2-100	25	560	186	152.3
Bordeaux	8-8-100	38	460	86	
Tribasic $CuSO_4$	3-7-100	32	422	48	
Check	3-7	0	374		

TABLE 2.—*Weight of tomato vines and green fruit left at end of harvest*

Treatment	Per cent of Maximum Weight Obtained	
	Vine Weight	Green Fruit Weight
Tribasic $CuSO_4$	100	100
Bordeaux	93	53
Spergon	87	74
Check	58	25

after an attack by *Alternaria,* the plant soon dies. Vine weight, therefore, becomes a measure of disease control. The amount of green fruit is a measure of how early death occurred, since vines dying early would have low quantities of green fruit at the end of the season.

Results of these tests indicate that tetrachlorquinone, though slightly inferior to copper sprays in disease controlling power, may, under proper conditions be a better spray treatment, owing to its "stimulative" action on the plant. No foliage injury by this material has been observed on tomatoes.

On potatoes, tetrachlorquinone has had only limited use as a foliage spray. It is our understanding that the wettable grade has been employed in tests in Florida during the past season, and that control of late blight by this grade was very poor. This probably is caused by the low tenacity of the material in the presence of a wetting agent, rather than by a failure of tetrachlorquinone to act as a fungicide.

Whenever tetrachlorquinone has failed to be effective in foliage tests, it is the wettable grade which has been employed. Probably the present type of wettable grade should be withdrawn from the market before further failures brand this material as inadequate.

2. *Tetramethylthiuram disulfide (TMTD, TUADS, Thiosan, Arosan, Dubay 1205FF)*3. Tetramethylthiuram disulfide was first reported as a useful foliage fungicide in England by Moore, Montgomery, and Shaw (26). There it was used successfully in the control of apple scab. In the United States it has only recently been introduced as a seed protectant and the experiments testing its possible value as a foliage spray are few indeed.

Sprague (32) first reported successful results with tetramethylthiuram disulfide as a seed treatment for wheat smut in 1939. Leukel (21) has found Thiosan (containing 50 per cent active ingredient) inferior to New Improved Ceresan for the control of covered smut of barley, though better than other treatments available if mercury and copper compounds should become unavailable. Thiosan has been employed against sorghum smut with encouraging results at dosages as low as one-fourth of those recommended (22, 23). It has likewise proven efficacious as a seed protectant on peas and spinach. (18).

Tetramethylthiuram disulfide has been found very useful for the treatment of turf diseases in golf greens (15, 27). For this purpose it is diluted with sand, broadcast over the infected areas, and watered into the grass lightly.

As a foliage spray, tetramethylthiuram disulfide has been tested by us for the control of diseases of apples, tomatoes, and roses. For apple scab, its performance was only fair, whereas for cedar apple rust on the Wealthy variety, it was highly effective in small, unreplicated plots.

Applied to roses for the control of black spot, pure tetramethylthiuram disulfide has given excellent results without injury. In a greenhouse operation, a house of badly infected plants was sprayed and the disease was eradicated within a four-week period. Stoddard and Heuberger (34) have also reported excellent control of carnation rust in greenhouse operations.

On tomatoes for the control of *Alternaria* blight, the 85 per cent grade of tetramethylthiuram disulfide (DuPont Japanese Beetle spray) was applied in 1941 and again in 1942. Sprays were applied with knapsack sprayers to 10 plant plots, in 4 randomized replicates. Plots were rated for disease control, as reported above. Table 3 lists the performances observed. The following materials were applied in the dosages

shown: Bordeaux mixture, 8-8-100; yellow cuprous oxide, 2 lbs. per 100 gals. on a copper basis; TMTD, in 1941 at 4 lbs. per 100 gals., and in 1942 at 2 lbs. per 100 gals. The check, of course, was unsprayed.

TABLE 3.—*Efficacy of various spray treatments in controlling Alternaria blight of tomatoes, and effect of these treatments on yield of marketable fruit*

Treatment	Dosage (Pounds per 100 Gals.)	Per cent Disease on Dates Shown			1941	1941	
		1941		1942	Weight Green Fruit (Ounces)	Total Number	Fruit Weight (Ounces)
		Aug. 22	Sept. 7	Aug. 28			
Bordeaux	8-8-100	40	27	..	434	539	2266
Yellow Cu_2O	2-100*	29	17	29	386	467	2069
TMTD	4-100**	41	30		620	564	2308
	2-100			46			
Check	..	36	100	92	244	380	1816

*Dosage computed on a copper basis.
**Tetramethylthiuram disulfide was applied at a dosage of 4 lbs. per 100 gallons in 1941, and at 2 lbs. per 100 gallons in 1942.

Indications are that tetramethylthiuram disulfide gave good disease control—considering the fact that this is a difficult disease to control.

So far as we know, tetramethylthiuram disulfide has never been tried as a foliage spray on potatoes, except at New Haven in 1942 (18). It was used on Cobblers and on Green Mountains for flea beetles and for tip burn (tables 4 and 5). Tetramethylthiuram disulfide was introduced as a Japanese Beetle spray, and it definitely reduced the number of flea beetles on the Cobblers and increased the yield when applied at dosages of 3 lbs. per 100 gals. It was tested as a sulfur activator on tip burn control for Green Mountains, and definitely reduced the tip burn below that obtained in the sulfur plot. It appeared to increase sulfur dwarfing as well, although the yield was still above that of the checks (18).

3. *Derivatives of diphenylamine.* Two groups of related compounds have been investigated in this category. These are the oxidation products of phenothiazine, notably phenothiazone, investigated by Goldsworthy and Green (11, 12) and 2,4-diaminodiphenylamine, developed as a fungicide by Goldsworthy, Green, and Haller (13). Neither of these compounds has been tested extensively outside of the laboratory. In

TABLE 4.—*Value of Bordeaux mixture, TMTD, and Derris dust as treatments in reducing damage by flea beetles to Cobbler potatoes*

Treatment	Concentration (Lbs/100 Gals)	Gals/Acre	Flea Beetle Damage Per cent	Yield Bu/Acre
Check	....	...	48.5	245
Bordeaux	2-2-100	400	31	253
Bordeaux	6-6-100	400	34.5	215
TMTD	0.34-100	400	50.3	259
TMTD	1.0-100	400	28.9	245
TMTD	3-100	400	29.5	287
Derris dust	1%	40 lbs.	7.2	305

TABLE 5.—*Value of various spray treatments in reducing tip burn on Green Mountain potatoes*

Treatment	Concentration (Lbs/100 Gals)	Gals/Acre	Tip Burn Per cent (May 10)	Yield Bu/Acre
Check	..	...	87.3	243
Bordeaux	1.5-1.5-100	200	30.5	393
Sulfur	1.5-100	200	78.5	286
Sulfur plus TMTD	1.5-0.15-100	200	53.5	254

our tests, 2,4-diaminodiphenylamine has not looked promising as a pea seed protectant (18).

Phenothiazine has proven only fair as a foliage spray against apple scab, when applied at the rate of 4 lbs. per 100 gals. (11, 12), whereas 2,4-diaminodiphenylamine has given as good control of apple scab as that obtained with the standard treatment of lime sulfur under Maryland conditions. With the latter material, only moderate control was obtained when it was applied to peaches for the control of brown rot and scab (13).

Tests for foliage injury have been made on apple, pear, plum, cherry, peach and on beans. All tests were negative, excepting phenothiazone on peach foliage, where light injury was observed.

Phenothiazine is in commercial production for use as an anthelmintic, and 2,4-diaminodiphenylamine is made under the name of Oxynone by Monsanto Chem. Co.

4. *The salicylates.* Clayton (2) has recently reported results of tests in which bismuth subsalicylate and benzyl salicylate gave excellent control of downy mildew of tobacco, the latter compound being used with cottonseed oil. Salicylic acid and zinc salicylate were effective as fungicides but tended to be injurious. Butoxyethyl salicylate, dinitrosalicylic acid, and salicyl salicylate were also promising. All of these compounds with the exception of the first were tested at the very low rate of ¼ to ½ lbs. of organic in a gallon of cottonseed oil which was then emulsified in 100 gals. of water. Bismuth subsalicylate was employed at 1½ lbs. per 100 gals. of water.

In evaluating these results it should be borne in mind that tobacco seedlings are very readily injured. Materials causing no injury on this crop would likely be safe on potatoes. The chief handicap to the use of these materials on even an experimental scale at the present time is lack of a source. Our laboratory tests with two fungi indicate that these materials may not work very well on the more resistant fungi, though it should be borne in mind that the causal organisms of blue mold of tobacco and of late blight of potato are closely related.

5. *Mercaptobenzothiazole* has been investigated, both as a seed protectant and as a foliage spray on apples for scab and rust. Its performance in all tests has been only mediocre, and, considering its cost in relation to performance, it is a material hardly worth further experimentation.

6. *Miscellaneous possibilities.*

a. *Para-dichlorobenzene.* The use of p-dichlorobenzene as a fumigant for the control of downy mildew of tobacco is well-known. It therefore should have possibilities in control of downy mildew (late blight) of potato. It cannot, of course, be used in the field as a fumigant, but the possibility has occurred to us that it might be tried as an emulsion by first dissolving it in cottonseed oil and emulsifying the oil in water. This combination, to our knowledge, has not been investigated as a foliage spray under field conditions, and its value, therefore, cannot be assessed.

b. *Pentachloronitrobenzene* has been employed in England as a dust for the successful control of Botrytis, damping-off and mildew of lettuce (31). Its further possibilities as a spray have not been investigated. Some injury has attended its use, although the relationship between dosage necessary for disease control and minimum dosage for host injury has not been determined.

Metal Salts of Organic Compounds

1. *Metallic dimethyldithiocarbamates.* A number of these compounds have been investigated by Goldsworthy, Green and Smith (14). The soluble sodium salt has proven too injurious to foliage and the copper and mercury salts have given injury to apple, peach, and bean. According to them, the lead salt is the most promising of the group tested. They applied both the lead and iron salts to apples and successfully controlled scab with them in 1941. The iron salt controlled scab and brown rot of peach with slight foliage injury, though control of cherry leaf spot by this material was not satisfactory. Tisdale (35) has reported similar results with the iron salt and has indicated that it is compatible with lime.

The iron salt, ferric dimethyldithiocarbamate, has been under experimental investigation for several years and has now been introduced commercially (Fermate, Dubay 870, IN-870). Our own experience with this compound has indicated its ability to control apple scab and rust under 1941 conditions in Connecticut.

The usefulness of ferric dimethyldithiocarbamate as a seedbed spray for the control of downy mildew of tobacco has been attested by Anderson in Connecticut (1) and by Kincaid in Florida (19).

Stoddard and Heuberger (34) have successfully controlled carnation rust with this material under greenhouse conditions.

Several reports by users have stated that the plants sprayed with it had a strikingly darker green appearance than do plants sprayed with other materials effective in controlling disease. Since the ferric salt is a coal black material, the darker color of sprayed plants is not startling. The dark color will persist as long as the spray residue remains on the plant in any appreciable quantity.

The only tests which have come to our attention, involving the application of ferric dimethyldithiocarbamate to potatoes as a spray are those reported by Dr. W. H. Tisdale of DuPont. His tests indicated favorable action against *Alternaria* blight. Its efficacy against downy mildew of tobacco may possibly indicate its efficacy against downy mildew of potato (late blight).

2. *The copper xanthates.* This group of compounds was investigated by Goldsworthy, Carter, and Green (10) but none of them has given satisfactory control of diseases under field conditions.

III. Solving the Limitations of Organic Copper Substitutes

There are several drawbacks to all the possible copper substitutes. In general, the organics have a lower tenacity by far than that possessed

by Bordeaux mixture and the cuprous oxides. They are too expensive at the present time to be used as foliage sprays, except in special cases. They are highly specific in their action against fungi, being completely effective against one organism and wholly ineffective against another. Finally, even if the ideal organic compound were found, problems of producing it in such great quantity as would be necessary in order to replace copper would be exceedingly great. None of these objections is insurmountable, however, and a few ways of approaching the problems confronting us at the present time might be discussed.

An attack upon the problem of improving the tenacity of organic fungicides is essential. Use of stickers and adhesives has improved tenacity somewhat, but has by no means solved the problem. A study of the relation between tenacity and the physical properties of individual samples of a material is badly needed, for only when we know that we can improve tenacity by modifying certain physical properties of a promising fungicide can we say that we really know much about tenacity and the principles governing it.

Tenacity is, of course, associated with such properties as solubility in water, volatility, etc., and these will vary with the compound, rather than with the sample of a compound. Some other properties, such as particle size, and surface activity will vary from sample to sample of the same compound and when the factors which determine the tenacity of a given material are known, we shall be able to improve greatly those materials which we now have.

In order to overcome certain inconvenient physical properties, and to get better spreading of spray over leaf surfaces, we have employed wetting agents. These do accomplish their direct objectives, but generally tend to lower the tenacity (resistance to weathering) of fungicides with which they are combined to such a degree that resulting performance is lowered.

Much, of course, remains to be done to find the crop and weather limitations and the limitations in ability to control disease of the three compounds which are currently available as substitutes for copper. This type of work can best be done on a wholesale basis all over the country. It is being fostered by the Fungicide Committee of the War Committee of the American Phytopathological Society.

The high cost of organics may prove to be one of the simplest obstacles to overcome. Their cost at the present time has limited their use as seed protectants. The obvious solution to this problem is to mix them with an inert filler, but potency is immediately reduced as dilution of the toxicant is increased. True, this decrease in toxicity is

not proportional to dilution, but tenacity has generally fallen with dilution, so that the combined fungicidal action and resistance to weathering falls off about as rapidly as the concentration of the toxicant.

This problem is now receiving some attention, and may be solved by finding methods of spreading a toxicant over the surface of a cheap inert carrier in such a manner that neither fungicidal power nor tenacity are sacrificed. If this can be done, then cost of the final fungicide will approach that of the inert filler. A carrier costing 10 cents a pound, used in conjunction with an organic fungicide at $1.50 a pound could conceivably be made to sell for 11 cents to 15 cents a pound without much sacrifice in efficiency. Incidentally, this would solve some of the problems of production, since a pound of pure organic fungicide could be made to do ten times the work it formerly did.

Summary

From the above discussion it is evident that there are a number of materials which are useful as copper substitutes both as seed protectants and as foliage sprays. At the present time three materials are in production and have the abilty to control disease. These are tetrachlorquinone (Spergon), tetramethylthiuram disulfide (Thiosan and Dubay 1205 FF), and ferric dimethyldithiocarbamate (Fermate, Dubay 870, and IN-870). All of these have shown excellent disease controlling power under field conditions on a number of crops. Doubtless there are other materials of equal promise. We have, in fact, tested a number of other organic compounds and some copper salts of organic compounds which have made excellent showing under field conditions, but these compounds are not on the market or else have not been tested sufficiently widely to be safe to recommend for large-scale use at the present time. The three mentioned are merely the beginning; the possibilities remain legion in the field of copper substitutes.

Shortcomings of the copper substitutes are their high cost, their limited production, their high specificity, and low tenacity. Methods of surmounting these difficulties are discussed.

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THE POSSIBILITY OF REDUCING THE PROPORTION OF PHOSPHATE IN FERTILIZER APPLIED TO SANDY SOILS

JOHN BUSHNELL

Ohio Agricultural Experiment Station, Wooster, Ohio

Where fertilizer is used in large amounts, the phosphorus applied far exceeds that removed by the potato crop. For example, a ton of 4-8-8 or 5-8-7 contains 160 pounds of phosphoric acid whereas 400 bushels of tubers contain only 30 to 40 pounds. As is well known, the excess is applied to allow for fixation of phosphorus by the soil, and still have plenty for the plants. As is also well recognized, no appreciable amount is lost by leaching, but the excess remains fixed in the plowed layer. With repeated applications, the phosphorus-fixing capacity of the soil will inevitably, sooner or later, become saturated, and an application of excess phosphorus presumably will cease to be necessary.

That soils may contain enough available phosphorus for potatoes is obvious from the fact that many soils in the semi-arid West do not need any fertilizer whatever. In the East, however, there are no large areas where the soils have been so thoroughly phosphated as to be recognized as not needing an excess in the fertilizer. On the other hand, there are scattered reports indicating that at least some of the sandier soils of the East have been phosphated to the point where further excess applications might well be discontinued.

As early as 1933, Odland and Crandall in Rhode Island (6) reported a fertilizer experiment with cabbage where for 8 seasons an 8-0-8 gave as good yields as 8-8-8 fertilizer. In 1937, Hester in Virginia (4) estimated the fixing capacity of Sassafras sandy loam as 5000 pounds of phosphoric acid per acre and found that some growers' soils contained more than this amount. Recently, Chenango sandy loam at the Washington County Truck Experiment Farm in Ohio was found to contain sufficient available phosphorus for several vegetable crops (2). The first report with potatoes was by Brown (1) who found that phosphate was not needed in the Connecticut River Valley on old tobacco soil. His data indicate, moreover, that the application of 5-2-6 fertilizer may actually result in higher yields than the continued use of

5-8-6. Five-year average yields were as follows, with a difference of 23 bushels per acre required for statistical significance:

Fertilizer Applied at Rate of 2000 Pounds per Acre	Average Annual Yield in Bushels per Acre
5-8-6	241
5-6-6	252
5-4-6	254
5-2-6	267
5-0-6	257

The first similar test with potatoes on Chenango sandy loam in Ohio was in 1941 and the yields were as follows:

Fertilizer Applied at Rate of 1500 Pounds per Acre	Yield of No. 1 Grade Potatoes, Bushels per Acre
6-8-8	317
6-4-8	320
6-0-8	318

Estimates of the Available Phosphorus Required by Potatoes

After the Connecticut experiments of Brown had produced five crops with no diminution of yield on the plots receiving no phosphate, the soil was tested by Morgan and Jacobson (5). They found 276 pounds of available phosphorus per 2 million pounds of soil by Truog's test (7). The soil of the Ohio experiment similarly tested 200 pounds per acre (assuming 2,000,000 pounds of soil per acre).

Both of these soils may contain *more* available phosphorus than actually needed by the crops. Neither experiment has been carried to the point where yields started to decline. Therefore, all that can be said at present is that 200 pounds or more of available phosphorus in these soils is somewhere above the threshold of the amount which would be just sufficient for a current season's crop. Threshold values, however, have been fairly well established for tomatoes and cabbage on Chenango sandy loam in Ohio (3). Tomatoes proved very sensitive, thriving only when the soil contained 180 pounds or more of available phosphorus, whereas cabbage required only 100 pounds per acre by Truog's test. Potatoes resemble tomatoes in being relatively poor foragers for phosphorus, hence the threshold of available phosphorus for potatoes is probably close to 200 pounds per acre.

Incidentally, the total phosphorus in the soil of the Connecticut experiment was 2,740 pounds and of the Ohio experiment 1,500 pounds per 2 million. The difference is not of importance in this discussion.

The point is that the total phosphorus was not exceptionally high, even in the Connecticut soil.

Practical Conclusions

Since the function of fertilizers is to supply nutrients which are deficient in a soil, it is obviously uneconomical to continue to apply large excesses of phosphate after the phosphorus-fixing capacity of the soil has been saturated to the point where ample phosphorus is available for a crop. Wherever a soil is suspected of being at this point, the reasonable procedure is to have the soil chemically tested for "available" phosphorus (the writer prefers Truog's method) and if the test shows more than 200 pounds per acre, then conduct a field trial to compare a standard fertilizer with a special mixture supplying about 40 pounds of phosphoric acid per acre.

If the field trial confirms the chemical test, the fertilizer tentatively recommended in Ohio is 1000 pounds of 8-4-12, and the Connecticut recommendation is equivalent to 1000 pounds of 8-4-16 per acre. Fertilizers with these formulas are, however, not on the market. In Ohio, growers have been advised to mix at home 500 pounds of 0-8-24 (a standard fertilizer for muck soil) with 375 pounds of sulphate of ammonia or its equivalent of any nitrogen carrier they prefer.

These suggestions are advanced primarily as a matter of economy. The saving in Ohio is five dollars or more per acre. There is also the possibility, as indicated by the Connecticut data, that a low-phosphorus fertilizer may actually produce a higher yield than a standard grade.

Addendum: After this article was written, further evidence that 4 per cent of phosphoric acid in a fertilizer may be ample was published by Chucka, Hawkins, and Brown in Maine Bulletin 414, "Potato fertilizer-rotation studies on Aroostook Farm, 1927-1941." They reported exactly the same yield from 4-4-7 as from 4-12-7, both averaging 384 bushels per acre.

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SOME VARIETAL DIFFERENCES IN WIREWORM INJURY TO POTATOES

W. A. RAWLINS

Cornell University, Ithaca, N. Y.

Varietal differences in wireworm injury to potato tubers have been noted in several instances during recent years. This is rather interesting since the common species of wireworms are generally injurious to most farm crops, particularly potatoes. Potato tubers are especially vulnerable to attack by wireworms; hence it is surprising to find variations in amounts of injury to different varieties.

Instances of crop resistance to wireworm attack have been recorded but no detailed account of potato varietal differences has been noted in the literature. It may be of interest then to discuss data obtained from several variety trials conducted in Western New York from 1937 through 1940.

The experimental plots were planted in fields infested with the eastern field wireworm, *Limonius agonus,* a pest common to the sandy soil types in New York State. Each experiment included a number of commercial potato varieties, most of which are commonly grown in the state. The row plots were 60 to 75 feet in length and each variety was replicated four or five times. At harvest time tuber samples of 100 number one size tubers were selected at random from each plot. The tubers were carefully examined and classified according to the amount and severity of damage. The injured tubers were graded into three groups; (1) tubers with one tunnel, (2) tubers with two to five tunnels, and (3) those with six or more. These classes are arbitrary and were designated as slight, medium and severe, respectively.

The data have been analyzed statistically by the use of the analysis of variance and summarized in table 1. Wireworm damage was heavy in all of the experiments except number 5 conducted in 1940. Significant differences in injury among some of the varieties are evident in all of the trials, but the order of susceptibility is not consistently the same in each experimental trial. In general, Irish Cobbler and Bliss Triumph were injured considerably more than Russet Rural, Heavyweight or Warba. Other varieties were intermediate.

The data may be analyzed further by indicating the severity of damage on the injured tubers. This has been done as previously stated by assigning each injured tuber to one of three categories according to the degree of injury. As will be noted in table 2, the more susceptible

TABLE 1. *Varietal differences as reflected in the amount of wireworm injury to potatoes.*

Variety	Average Number of Tubers Injured per 100 Tuber Sample				
	Expt. 1	Expt. 2	Expt. 3	Expt. 4	Expt. 5
	1937	1938	1938	1939	1940
Irish Cobbler	53.5	75.0	61.3	70.6	17.8
Bliss Triumph		64.3		73.0	19.6
Green Mountain	59.4	75.3	52.7	55.0	16.8
Burbank Russet	46.5		74.8	50.6	
Chippewa		67.8	66.5	48.2	
Katahdin		67.3	56.0	45.6	
Heavyweight	24.7	51.0	52.7	45.4	13.4
Russet Rural	33.1	48.0	60.8	43.4	18.0
Warba		49.5	38.8	38.6	7.2
Least difference for significance 19:1	23.5	10.7	11.8	11.0	

varieties tend to have fewer slightly injured tubers and more severely tunneled tubers than the more resistant varieties. The injury on Irish Cobbler, for instance, showed an average of 26.7 per cent in the slight and 22.3 per cent in the severe classes, whereas Warba with fewer injured tubers had 51.8 per cent in the slight class and 9.0 per cent in the severe.

TABLE 2. *Severity of wireworm damage to potato varieties in experiments 2, 3 and 4.*

Variety	Total Number Tubers Injured	Percentages of Tubers in		
		Slight	Medium	Severe
Irish Cobbler	898	26.7	51.0	22.3
Bliss Triumph	622*	35.5	49.7	14.8
Green Mountain	787	35.2	47.0	17.8
Chippewa	778	33.0	40.6	26.4
Katahdin	721	34.4	47.4	18.2
Russet Rural	652	41.3	46.9	11.8
Heavyweight	642	42.5	47.2	10.3
Warba	546	51.8	39.2	9.0

*Bliss Triumph was not included in experiment number 3.

No basic reason for the varietal differences noted is evident. Therefore, these variations may not be due to any inherent characteristic in the varieties. Maturity which might affect the time of tuber setting is apparently not a factor since two of the earliest varieties on trial, Cobbler and Warba, differed widely in susceptibility to attack. It has been pointed out (1) that in case of the eastern field wireworm, *Limonius agonus*, the larvae cease feeding in late August; hence tubers set late in the growing season were not injured as severely as those set early. This would not be the case in the variety trials since most of the tests were planted early in the season.

Summary

In a series of potato variety trials small but significant differences among varieties have been observed. Although all varieties tested were subject to wireworm attack, some varieties appeared to be more susceptible than others.

LITERATURE CITED

Rawlins, W. A. 1940. Planting dates as affecting wireworm injury to potato tubers. Jour. Ec. Ent. 32: 761-765.

SECTIONAL NOTES

ALABAMA

The commercial season was practically completed by the end of May, although small movements continued during the first week of June. The season was a successful one. Returns were satisfactory and growers as a whole were satisfied. Early in the season, there was much concern over price differentials which gave Alabama lower prices than competing states. Although prices would have probably been higher had ceilings permitted, the prices received were considered by most growers as good.

The labor shortage was met by the use of high-school boys who volunteered for work during the harvest season. These boys were recruited by the Extension Service, were housed locally, and their health and recreation supervised by the Extension Service and local and state health officials.

Alabama did not use the Victory grade which was used by some of the other states. They were permitted to place in each car 240 bags

of U. S. No. 1, A size; 50 bags No. 1, B; and 10 bags creamers, and to move these at ceiling prices.

Yields were good and favorable weather conditions greatly aided the movement of the crop, and the good carrying quality of the potatoes. The total shipment will probably amount to 5,000 cars. (June 10). —L. M. WARE.

CALIFORNIA

Shipments are continuing very heavily from Kern County but despite these shipments running between 400 and 500 cars per day, it is almost impossible to make any purchases. This is because of the fact that the potatoes have been bought up either by acreage or on other deals at ceiling prices.

The demand for California potatoes from the entire country is terrific.

The yields in Kern County are holding up in good shape. To date the weather conditions have been very favorable and with a heavy movement continuing, the Shafter District should clean up their potato crop by the early part of July.

The growers are trying to get their potatoes out of the ground before the weather turns too hot on account of danger of internal browning, etc.

Growers, handlers and railroads are doing a remarkable job moving the Kern County potato crop. The total volume shipped from Kern County this year should be the greatest that has ever been produced. (June 8).—E. MARX.

At the present time there should not be more than fifteen different firms or individuals shipping potatoes out of Kern County, as the potatoes have been sold in the field to approximately an equal number of firms.

Last year at this time there were approximately 125 to 135 representatives shipping potatoes nearly every day. This change has come about on account of O. P. A. rulings which have made it possible for the large operator to step into the field and purchase the potatoes in the field rather than by the car. Until last night, Friday the 28th of May, we had shipped 7,623 cars as against 6,522 cars on the same date in 1942 and 4,629 cars on the same date of 1941. We are now shipping more than 500 cars per day and will continue to ship in the neighbor-

hood of 500 cars daily for the next ten days, at least according to our best judgment. The O. P. A. has changed the ruling or price again, putting price ceilings on U. S. No. 1's until June 1, 1943, which will be $2.65 to the grower.

We are still having trouble with labor from two standpoints. In the first place we are facing a shortage of labor and these laborers are demanding more money. Potato pickers in the field today are, generally speaking, being paid 12 to 13 cents a sack for 100 pounds of potatoes. The average picker is making from $11.00 to $13.00 a day at this rate. Some of the labor, such as that used in hauling potatoes from the field are making $16.00 and $18.00 a day on piece work.

It might be interesting to know that on the 27th of May this year we shipped 501 cars; on the same date in 1942 we shipped 328 cars; and on the 27th of May, 1941, we shipped 197 cars. Apparently, from market news service records that are available to us here today, the only potatoes being harvested and marketed in California are those produced in this county. Then, too, the market news service records indicate that on the 27th of May there were 1,320 railroad shipments of which Kern County shipped 501, and Alabama shipped 278 cars. (May 29).—M. A. LINDSAY.

CONNECTICUT

Potatoes became so scarce on Connecticut markets that some retailers were selling them in three-pound lots at nine cents per pound. To make even weight, some tubers were sliced! This acute shortage of potatoes has stimulated many to plant small areas in their gardens and it is difficult to estimate how much effect on the total acreage these small plantings will have. Undoubtedly, it will be quite an important factor. Commercial plantings have been increased markedly but I haven't any definite values to report at this time.

At Storrs, the month of April was the coldest on record for fifty-four years. Both April and May had excess precipitation and all of this unfavorable weather delayed quite markedly the average date of planting potatoes. It has also increased the difficulty of keeping weeds under control. The first part of June, however, has been drier and consequently the weather has been much more favorable for the growth of all crops.

Farm labor is very scarce. First, because of the numerous factories in the state that are engaged in producing munitions; and secondly, because of the drafting of farm laborers. This labor shortage is

being remedied in part by the setting up of labor camps for preparatory school boys and importations of men from Jamaica and our southern states. (June 12).—B. A. Brown.

Georgia

Potato harvest is at its peak in the early section of southeastern Georgia. Yields were somewhat reduced this year, because of the late frosts, but, as a whole, production goals are being reached. The market continues to be steady, with ceiling prices.

In the commercial area of North Georgia, potatoes are growing rapidly under almost ideal weather conditions, and the predictions are that yields will be the highest in recent years. (June 8).—H. L. Cochran.

Idaho

Planting was in full swing in Idaho during the last two weeks of May and the first two weeks of June. A large acreage has been planted. Although most of the crop has been seeded by legitimate potato growers, there is a considerable acreage owned by others and, in many cases, this acreage is on marginal land and planted with seed of unknown quality. While the government report shows a twenty per cent increase compared with last year, local estimates run as high as 75,000 acres increase over last year's all time high of approximately 136,000 planted acres. Increases in dehydration equipment may be great enough so that 10,000 cars could be processed from next year's crop.

Inquiries from the seed areas indicate that there will be many new growers attempting to certify seed and that many of our former growers will be planting increased acreages.

Some of the commercial areas report decaying of seed pieces caused by the cold, wet weather, and there has undoubtedly been some injury from rhizoctonia in early planted fields of the late section.

Because of frost in the early Caldwell-Nampa section, harvesting will be later than normal.

Some growers are already thinking about harvesting and have made inquiries about methods for inducing early ripening.

Approximately two and one-half acres of tuber-indexed Idaho Russets and Bliss Triumphs have been planted in tuber unit plots. This program is a cooperative one involving the Idaho Branch Experiment Stations at Aberdeen and Tetonia, the University Extension Service, and the Idaho Crop Improvement Association.

Market activity for the past month has been at a low point with only a few clean-up cars being shipped. Potato growers have not experienced serious difficulties from labor shortages in getting the potato crop planted. Many women and also grade school children as well as high school children have assisted in cutting the seed and planting the crop. We anticipate that labor difficulties will be more likely to occur at harvest time. (June 14).—EUGENE W. WHITMAN.

INDIANA

The potato situation in Indiana is easing up a bit. Many of the early potatoes were up and in good shape when we had the heavy rains which caused considerable damage. This past week we located about 2,000 bushels for replanting in the lower Wabash River bottoms and since then I have had a number of requests coming in for more potatoes. Our planting season may be a little bit late for all parts of Indiaana and particularly in the muck region where there has also been considerable water. The potato bugs are quite numerous, leafhoppers, flea beetles, and the Colorado potato beetles being abundant, but the growers are doing a good job of controlling them. In the small patches, however, these insects have not been controlled well, and we expect considerable loss. This is the hardest thing we have to put across to our potato growers—to control these little pests and to apply the materials at the proper time.

Although we can't put a finger on any one as yet, the black market has certainly raised havoc with the potato situation, particularly for those people who have to buy. In some localities, they have been without potatoes for about a week and one county official in southern Indiana said, "We nearly starved to death for about a week because we couldn't buy any potatoes." The supply of early potatoes is only fair and the price is too high for the good of the cause. Some of our large potato growers are thinking about going out of business just when we need more and better potatoes. (June 7).—W. E. WARD.

MICHIGAN

Planting of potatoes, in general, is somewhat delayed. However, the northern one-half of the state, which is primarily the late-producing section, will be planted approximately the usual date, with most plantings completed by the 15th of June. The acreage will probably show some increase when the final plantings have been completed.

Production in the lower half of the state will be a big question

mark. This section usually is considered the early section, starting to supply the market by the middle of July. This area had all the indications of an increase in production this year; however, fields that were planted have been either too wet or have been under water for the past three or four weeks. There will not be enough seed to replant these fields if the fields do dry off. There is a small percentage of growers in this section who usually plant late, and if they can plant before the 1st of July they will do so.

The black market did make some inroads into the potato deal this spring. A good example of this black market can be noted by a U.S.D. A. release of April 15, 1943 (which indicates the average price farmers received on the 15th of April on the farm). This release reports that Michigan farmers, at the farm, averaged $1.80 per bushel which in any one's interpretation is $3.00 per hundred which, when compared with O.P.A. ceiling price for Michigan during April, was $2,35 per hundred by country shipper f.o.b. loading point. This leaves only one answer. Did a black market exist?

The intention for planting of certified seed acreage is quite comparable with that of last year with a slight increase. (June 9).—H. A. REILEY.

NEBRASKA

Potato growers in the Nebraska Panhandle are just beginning to plant. Although it is somewhat early for the main crop, an occasional grower usually begins planting about the 5th of June, and the majority of growers will be in the swing of planting operations by the 10th. Planting conditions are excellent. Timely rains have been received during the past two weeks, so therefore, at the present time, our prospects are very good.

The cold weather of May has benefited potato growers in another way. It has been possible for them to maintain low temperatures in their potato storage houses, and thereby maintain seed under ideal conditions. In some seasons, warm weather results in considerable sprouting, and seed losses prior to planting.

The original intentions to plant were based on a certain amount of loss of seed before planting time. Because of the excellent conditions of storage, this will probably result in even larger acreage than originally reported.

The acreage to be planted for certification will be approximately the same as last year, or slightly larger. In view of the fact that the acreage entered for certification has been dropping for the past two

years, this is a good indication. In the case of commercial plantings, the A.A.A. offices report smaller acreages than last year. Labor difficulties are primarily responsible for this. All growers are working under short-handed conditions, and feel that additional labor for the peak employment periods will not be available. Defense projects throughout the main potato growing area of Nebraska have been completed, so that there should be an easing of the local labor situation. Potatoes, however, are probably suffering, because farmers are increasing the acreage of other crops that are more readily handled by mechanical means.

There has been a moderate demand for seed up to this time, but of course, very little seed has been available for more than a month. Seed prices were right up at the ceilings imposed by O. P. A. There has been little black market activity recently.

The over-all picture for the potato grower looks quite good. Many growers are wondering what the price ceilings will be this coming year, and hope they will be high enough to cover cost of production and allow a moderate profit. (June 7).—MARX KOEHNKE.

NEW JERSEY

Growing conditions have been very favorable during the past few weeks and our potatoes are making good growth. Plants in South Jersey are now in bloom and those in the central part of the state will soon be just as far advanced. The stands of the Katahdins are somewhat uneven. *Rhizoctonia* has injured the stand in many fields; and in some areas growers are troubled with "blind sprout." Weeds are very troublesome in low areas, especially where the farmers have not been able to cultivate because of the heavy rains occurring the latter part of May. In general, the crop looks fair and prospects point to at least average yields. More rain is needed since the tubers are setting and the plants are developing so rapidly.

Supplies of spray and dusting lime have been limited. Calcium arsenate, for the control of insects is also difficult to obtain in some localities.

Offers for the new crop are already being made above ceiling prices, indicating that black market operators are still in the picture. (June 15).—J. C. CAMPBELL.

NEW YORK

Almost continual rains throughout the month of May and into early June caused a serious delay in planting operations in upstate New

York. Many of the larger, more efficient growers found it impossible to finish their plantings before the 10th of June. Many fields will be planted as late as the 25th of June this year. This is almost certain to reduce the yield below that which it would have been had it been planted at an earlier date. Many growers were unable to get sufficient seed, some none at all. However, we believe that the scarcity of seed, as acute as it was, became most apparent because of the late demands from Victory Gardeners, and new growers of small acreages. The most serious phase of the situation is that much cut-seed spoiled because of improper storage and handling during the rainy period. There seems to be sufficient labor to finish planting, but the labor for harvest is more of a question.

At least 200 carloads of Maine seed, most of the seed of which is not certified, will be planted in upstate New York this year. This is very unusual. The New York supply of certified seed is reported by H. J. Evans, Manager of the New York Cooperative Seed Potato Association, to have been sold out as early as the 10th of March. Much seed that would have been planted was sold for dehydration.

Most of the Long Island plantings came up very slowly and unevenly but are now making good growth. A report from the Suffolk County, Long Island Farm Bureau indicates that late blight has already appeared on the north fork of the Island. This has resulted from cold night temperatures and recent rains.

This year has been a hard year for the muck land potato growers in the Wayne, Montezuma, and Canastota areas. Much of the early-planted seed has completely decayed and may not be replanted because of the late season and scarcity of seed. Most of the Montezuma muck area in Cayuga and Wayne Counties will not be planted to potatoes because of excessive rainfall and standing water. Conditions are nearly normal in the Elba muck area of Genesee and Orleans counties.

During the past week, planting has progressed rapidly in Steuben and Allegeny counties. (June 15).—E. V. Hardenburg.

NORTH CAROLINA

Light movement of potatoes began in Eastern North Carolina on the 9th of June, at which time two cars were shipped. Harvesting began, generally, on the 14th of June, and 99 cars were moved on the 15th. It is indicated that peak shipments will not be reached until the latter part of June or the first part of July. Wire inquiry was very heavy on the 15th of June and the demand exceeded the supply.

Laborers were rapidly moving into camps about the 13th of the month and a plentiful supply was indicated. In fact, one camp was over-crowded and workers were moved to another. These camps have been established at five locations under the supervision of F.S.A.

Our growing conditions were good during the first part of June, with sufficient rains and cool temperatures. Therefore both the yield and the quality of the tubers are better than we anticipated. (June 15). —M. E. GARDNER.

LONG ISLAND

In general, the potatoes on Long Island have germinated well and are off to a good start. The crop is slightly later than normal. Long Island has the largest acreage ever planted to date. Much less land than normal has been saved for the planting of Lima Beans, Brussels Sprouts, and Cauliflower.

This means that there will be a lot more potatoes harvested and sent to market in July than in former years, to provide land on which to plant those other crops as "Second crops."

With favorable climatic conditions during the season, Long Island should at least have a normal crop. (July 6).—H. R. TALMAGE.

OHIO

Wet weather continued throughout May. Rains have been scattered during the past two weeks and most sections in northern Ohio have had a few days for planting. There are still some late potatoes that have not been planted. The Sebago acreage has greatly increased this year.

The prospects are excellent for a large early crop, providing rains occur regularly. The heavy rains in May have packed the soil and most plants are shallow-rooted. For these reasons drought would be serious.

Although more potatoes have been on the markets during the past two weeks, reports still show black market operations. The so-called "side money" seemingly gets the potatoes. (June 14).—E. B. TUSSING.

OREGON

Potato acreage for the state has stepped up from approximately 37,000 to 50,000 acres. Increases are more or less general throughout the state, but the largest single increase in the percentage is in Malheur County near the Idaho line in southeastern Oregon. There the acreage

has more than doubled, mostly as a result of the floor price announced for potatoes. Part of the increase has been due to the need for potatoes at a large dehydration plant nearby—across the line in Idaho.

Seed potato acreage will probably be the largest for many years. The only factor that will hold it in check is fear of insufficient labor for roguing.

We have had very little black market activity, if any at all. It is probable, however, that some certified seed was used for table stock. If this is true it is not on much of a scale. We had no absolute potato famines such as those reported from the East. In other words, it was always posible here to buy potatoes, but there was a great deal of selling of culls, and in the end culls sold for about the same price as No. 2's. Aside from Malheur County, marked increases will occur in the well-known Netted Gem areas of Klamath and Deschutes. All the foregoing areas are irrigated and all that are in eastern Oregon. Across the mountains to the west where potatoes are grown without irrigation, there is also a marked acreage increase following the call to produce as many potatoes as possible. Had it been possible to buy planters and diggers and to get fertilizer in unlimited amounts, we would have had a much larger acreage.

Growers are a little concerned about the nitrogen situation for next year in that they have been informed that they may have to use ammonium nitrate. In addition, it is difficult to use because it absorbs water so readily. However, it is better than no fertilizer, and if we have to use it, our growers will work out proper methods for its use. (June 12).—E. R. JACKMAN.

Most of the potatoes in this area were planted by the end of May. However, a few late plantings were made during the first part of June.

At the present time many of the plants have emerged and appear to be in good condition although cold rainy weather during the latter part of May retarded the growth to a certain extent.

The labor situation is constantly in mind and harvest labor need is expected to be at its peak about the 15th of October. The county farm labor committee is making plans to take care of the situation as well as possible. (June 12).—J. R. McCAMBRIDGE.

PENNSYLVANIA

Applications for seed potato certification are being received. Last year there were 1,505 acres of potatoes entered for seed certification. An increase in the acreage is anticipated this year.

Early planted fields are coming into bloom. Stands are good and the plants are making excellent growth. Weeds are a serious problem, especially in the early planted fields. They will no doubt interfere somewhat with the development of the crop later.

Leafhoppers are quite serious and flea beetles have done some damage.

Some seed fields are still being planted in the northern-tier counties.

Weather has been favorable not only for plant growth, but also for late-blight, although late-blight has not been reported as yet this season. (June 15).—K. W. LAUER.

CANADA

During the past few years, potato acreages in Ontario have been greatly reduced while imports have increased tremendously, there being 1,139 carlots brought into the Province in 1931, as compared with 4,003 carlots in 1941. For the first four months of 1943 there were 1,727 carloads imported.

Records for the past sixty years show that the Provincial potato acreages for the respective years of 1941 and 1942 were the lowest in history. One hundred twenty-two thousand acres were produced in 1942. The average yields have declined from 68.1 cwt. per acre in the ten-year period 1891-1900 to 59.3 cwt. per acre for the 1931-'40 period. The general opinion seems to be that quality has not improved.

Because of the heavy losses in 1942, from leafhopper and blight injury, together with increased consumption demands, practically all supplies of Ontario potatoes were exhausted early in the season. The extremely long and severe winter period together with the shortage of railway cars, complicated difficulties in obtaining supplies from outside sources. Supplies have not been sufficient for demands since early in the new year. Although the acreage planted for the early crop in 1943 is about the same as normal, cold, backward weather conditions have not favored growth, and the yield will be below normal. Digging will be at least 10 days to 2 weeks later than usual.

Due to our unusually large number of farmers requiring seed this year for late planting, coupled with heavy demands for Victory Gardens, and scarcities of table stock potatoes the market for certified seed has been keen.

As ceiling prices were not established for certified seed, even though prices for table stock were definitely set, substantial and unusual differentials developed between table stock and seed prices. Extremely high

prices for seed discouraged potato acreages, and plantings have been reduced at a time when increased production is urgently requested.

Many growers have planted any available table stock, and also many varieties which are not well adapted to average Ontario conditions.

Growers who are giving proper attention to the use of good seed, providing abundant supplies of readily available plant food, and protecting the growing crop against leafhoppers and late blight, may expect good results by increased production per acre.

However, scarcities and costs of labor, machinery, and seed are responsible for a considerable reduction in aggregate acreage, which, no doubt, will have marked and important effects on transporation and food supplies during the 1943-'44 winter season. (June 12).—R. E. GOODIN.

Erratum

May Issue, Vol. No. 20, No. 5, 1943.

CANADA

In the Sectional Notes of the May issue of the American Potato Journal there are three misprints in connection with the standard for Canadian Foundation and Foundation A seed potatoes.

At the bottom of page 139 under "Foundation A" it is stated, "Tolerance for any one virus disease not to exceed 5%." This should be .5%.

On page 140 the present Foundation standards are given as:

"1st Field Inspection, Total Diseases 5%
2nd Field Inspection, Total Diseases 1%."

The two tolerances should be .5% and .1%, respectively.

To avoid any possible misunderstanding, the correct standards are as follows:

"Foundation A

(a) If field or plot is planted in tuber units:

1st and 2nd Field Inspections—Tolerances for any
one virus disease not to exceed .... .5% (½ of .1%)
Total virus diseases not to exceed 1%

(b) If not planted in tuber units:

The tolerance shall be those allowed under the present Foundation standards, namely:

1st Field Inspection, Total Diseases .. .5% (½ of 1%)
2nd Field Inspection, Total Diseases .. .1% (1/10 of 1%)"

W. N. KEENAN.

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SUGGESTIONS ON INDUCING EARLY GERMINATION OF POTATO TUBERS IN GREENHOUSE TESTS FOR VIRUS

F. E. Denny

Boyce Thompson Institute for Plant Research, Inc., Yonkers, N. Y.

Samples of tubers taken from fields of planting-stock quality are commonly sent to Florida for a field-test of the presence of virus. Such tubers are in the rest period, and ordinarily a uniform stand of young plants cannot be obtained until two or three months after harvest.

By the methods here described the testing of recently-harvested tubers can be begun in greenhouses within a week or so after harvest. Plants of a suitable size for indicating symptoms of virus can be obtained within a period of one month from treating and planting. After the counts on the lots first occupying the greenhouse space have been made, another series of samples may be planted, and in this way the greenhouse space may be utilized two or three times successively before satisfactory germination could be obtained without the dormancy-breaking treatments.

It is suggested that these early treatments in the greenhouse may be found of value, not only for obtaining an early decision on the lots either obviously free or badly infected, but also for indicating the doubtful lots, so that time will still be available for a more extensive and critical test, either in Florida or in the greenhouse.

The object of this paper is to give the details of the methods of applying the treatments.

Methods of Treating Dormant Potato Tubers

Treatment of Cut Tubers. Remove a single cutting (seed-piece)

from each tuber (with identification mark on both mother tuber and cutting if desired, see below). Accumulate these seed-pieces in wide-mouthed fruit jars, one-quart or two-quart sizes, until each jar is full. Make up a dipping solution by adding 30 cc. of 38 to 40 per cent ethylene chlorohydrin (CH_2ClCH_2OH) to 970 cc. of water. Mix this thoroughly and pour about 150 to 200 cc. of it into one of the jars of cuttings, put the cover on the jar and shake it to bring the liquid in contact with all the tissue, and with the inside surface of the jar. Decant from the first jar into the second jar, invert the first jar (with hand over opening) and shake it to dislodge the excess liquid, crumple a paper towel and put in the neck of the jar, seal the jar and invert it. Let it stand in the inverted position at a temperature not below 20° C. (68° F.) nor above 24° C. (75° F.) for approximately 16 hours. Proceed with the second, third, and other jars until all the cuttings in the sample have been treated. The object of inverting the jar is to let the excess liquid drain downward and be absorbed in the paper toweling, so that no cutting will stand overnight in even a small amount of liquid. At the end of the 16-hour treatment the treated seed-pieces are ready for planting.

If the tubers are freshly-harvested Irish Cobblers or Rurals, or are small tubers of any variety, or tubers of any size from immature vines, it is advisable, though not always necessary, to use a combined treatment as follows: At the end of the 16-hour storage period (*i. e.*, after the ethylene chlorohydrin dip treatment has been completed) remove the crumpled paper from the neck of the jar, cover the potatoes with a solution made by mixing thoroughly 10 grams of NaSCN (sodium thiocyanate, sodium sulphocyanate) in a liter of water. Soak the potatoes for one hour, then remove them, rinse thoroughly under the tap or with at least three successive changes of water. Then plant the treated cuttings.

Treatment of Whole Tubers.. As containers for treating whole tubers, two-gallon glazed-earthenware jars are suggested. Weigh out enough whole tubers (labeled if desired, see below) to nearly fill the jar,—approximately seven to eight pounds. Crumple a paper towel and put it on the tubers. Tear off a piece of cheesecloth and add to it enough of the 38 to 40 per cent ethylene chlorohydrin solution to equal one cc. for each pound of tubers to be treated. Adjust the size of the cheesecloth so that there will be no dripping. For an eight-pound tuber sample, a suitable cheesecloth size is 10 inches square. Spread the cheesecloth loosely on top of the paper towel and seal the jar. A glazed earthenware saucer corresponding to the size of the jar may be used as a cover, or if more than one jar of tubers is to be treated the bottom of the

second jar may be used to cover the first jar, etc., forming a stack two or three jars high. Seal between the jar and the cover, or between jar and jar with modeling clay. The duration of the treatment should be four days and the temperature should not be under 20° C. (68° F.) nor over 24° C. (75° F.). At the end of the four-day treatment, do not plant at once, but remove the treated tubers and place them in a paper or burlap bag; let them stand in the bags at room temperature for one week, then cut into pieces and plant. The early stages of germination are proceeding during these days of storage and by the end of a week sprouts will be visible.

If the tubers are freshly-harvested Irish Cobblers or Rurals, or small or immaturely-harvested tubers of any variety, it is advisable, though not always necessary, to use a combined treatment as follows: At the end of the seven-day storage period after treatment, remove single cuttings from each of these tubers and proceed with the cut-tuber dip-treatment as described in the paragraph above: "Treatment of cut tubers." This is recommended even if the whole tubers show at this time some development of sprouts as a result of the whole tuber treatment. The cut tuber treatment is not injurious to these young sprouts and will improve the germination if the tubers were in deep dormancy at the time the original whole tuber treatment was applied.

Comments on Treatments

The Combined or Double Treatments. As stated above, the tubers of the variety Irish Cobbler are particularly difficult (as are also the Rural varieties, but to a much less extent), and whatever the variety, the small tubers (say less than 1.5 inches in diameter) are more dormant than the large ones of the same variety; and this is true of tubers from immature as compared with mature vines. It is particularly with such types of tubers that the combined or double treatments demonstrate their advantage. The double treatments have given good germination of the most difficult material yet tried, *i. e.,* small-sized, second crop, immature Irish Cobblers, harvested in early October from plantings made in August.

Occasionally sprouts from cut tubers receiving the sodium thiocyanate secondary treatment show yellowing of leaves in the early stages of growth, especially with Irish Cobbler. As the plants grow, however, this coloration gradually disappears, so that by the time the plants become large enough for observation as to symptoms, the effect is no longer noticeable.

Treatments of Tubers Late in the Rest Period. As the tubers

emerge from the natural rest period there is a time at which some of the tubers show sprouts while others do not. There is incomplete emergence from the rest period at this stage, however, and such tubers if cut and planted show an uneven stand. Treatments by the cut tuber method described above give an improvement in germination. This treatment is not injurious even to tubers with well developed sprouts and may be applied whenever it is not known whether the tubers are completely out of the rest period. It is not injurious to apply the double treatment (dip plus thiocyanate) but if the tubers show some natural sprout development it may be assumed that the secondary thiocyanate treatment is unnecessary.

If the tubers have emerged from the natural rest period sufficiently to show some sprouts, it is not advisable to apply the whole tuber treatment outlined above, as some injury to tubers may occur. At this stage either apply the cut tuber method or plant without treating.

Treatment of Larger Quantities of Whole Tubers. The two-gallon glazed-earthenware jars suggested above for the treatment of whole tubers are not the ideal size, and they were used merely because of their availability. A preferable size would be a jar about 16 inches in diameter and 9 inches deep, inside measurements. This would hold one-half bushel, or approximately 100 tubers. If the rims were of good thickness and were flat (squared off), a layer of modeling clay could be applied quickly to each rim, and the jars could be piled one above another, with a flat cover for the top jar of the tier. Using this method two persons could treat many bushels in a day. Presumably, such jars are not now available and would need to be specially made. If any readers are interested in getting some of these jars, the author will be glad to hear from them and if there are enough inquiries will determine whether such jars can be manufactured and at what price.

Rooms of various sizes may also be used but the loss of vapor will depend upon the permeability of the walls or openings, and the suitability of any given space cannot be estimated. Only an actual test can be dependable in such a case. When dealing with large quantities of the chemical in closed spaces it must be remembered that strong concentrations of the vapor must not be breathed for any considerable period. Good aeration must be provided in applying the chemical at the start, and at the conclusion of the treatment the space must be ventilated thoroughly before any one enters to remove the tubers. A commercial respirator for use in low concentrations of organic vapors (name and address of firm available on request) was tested in the laboratory and was found to remove successfully vapors of ethylene chlorohydrin from a current of air containing this chemical.

A plastic-impregnated tarpaulin (name and address of firm available on request), such as is used in fumigation with methyl bromide, was tested for permeability to vapor of ethylene chlorohydrin, and was found resistant to the passage of these vapors. Supplies of dormant tubers for a test of the possibility of tuber treatments using tarpaulin for a cover have not become available since this preliminary test.

There seems to be no fire hazard in the use of ethylene chlorohydrin under the conditions of these treatments.

An important disadvantage in treating the larger quantities in a given space is related to including in a single treatment tubers of different varieties, and of the same variety at different intervals after harvest. The permeability of the tubers under such conditions varies with the different lots, and an even distribution of the chemical among the lots may not be obtained.

On the whole, in tuber-indexing work in which there are many samples of different varieties from various sources, each sample consisting usually of 0.5 to 2 or 3 bushels, if the whole tuber treatment is to be applied, it seems better to treat each sample separately. Each lot will then be exposed to a specific amount of the chemical for a definite period. This results in a uniform treatment among the tubers and an even stand of sprouts from the treated seed-pieces.

Possible Modifications. The quantity of chemical, 30 cc. per liter, used in the cut tuber method is not the optimum amount, nor is the optimum duration 16 hours. A more effective treatment is 60 cc. per liter for the dipping liquid and a storage period of 24 hours. The use of the smaller amount for the shorter period was adopted in order to get well below the point of injury to the treated seed-pieces, so as to avoid loss from rotting insofar as possible. If the possible loss of 2 or 3 per cent of the cuttings in some of the lots would be of no importance in any particular case, the higher amount for the longer period might well be used.

Labeling of Tubers and Seed-Pieces

Prepare a water-proof ink by mixing a knife-point of Crystal Violet (a dyestuff available from laboratory chemical supply houses) with approximately 25 cc. of a white shellac solution (such as is obtainable from paint supply firms, or even from chain stores). Adjust the amount of the dye to obtain a dark colored ink, and thin the shellac to the proper consistency, if necessary, by adding denatured alcohol. As a pen point, the flattened-point type used by sign painters is preferable. With this ink and this pen, the mother tuber and the cutting removed

from it may be suitably numbered for identification. The mark will dry within a few minutes and will carry without blurring throughout the process of treating. The number will remain visible on the seed-piece even after the plant has become full grown, and even if the cutting rots, provided of course that the skin itself does not disintegrate. If the cutting fails to develop, or if there is any doubt as to the symptoms of the plant after it becomes full grown, the mother tuber corresponding to this number may then be recovered from the storeroom, and a new cutting for another test may be taken.

If the Crystal Violet dye is not obtainable, Nigrosine Jet, "spirit soluble," a black pigment used in the painting trade, may be used instead.

The ink mark should be at least a millimeter broad and the identifying numbers should be large. This is because the conditions in the soil sometimes lead to the formation of lenticel growths which obscure the numbers if the lines are narrow and small.

Strengths of Available Ethylene Chlorohydrin

Ethylene chlorohydrin is available commercially in two different strengths. One is the constant boiling mixture which contains 38 to 40 per cent of ethylene chlorohydrin by weight. The directions given in this article refer to the ethylene chlorohydrin solution of this strength.

The chemical is also available in the anhydrous form, *i. e.*, with all water removed. In that case the 38 to 40 per cent solution is prepared from the anhydrous as follows: to each 100 cc. of the anhydrous chemical add 178 cc. of water and mix thoroughly. The resulting solution will be approximately 38 to 40 per cent ethylene chlorohydrin by weight, and this is the solution referred to in the directions for treatments given in this article. That is, for the whole tuber treatments one cc. of this solution is used per pound of tubers, and for the cut tuber dip treatment 30 cc. of this solution are added to 970 cc. of water to form the dipping solution.

PURPLE-TOP WILT OF POTATOES CAUSED BY THE ASTER YELLOWS VIRUS

S. G. Younkin*
Cornell University, Ithaca, N. Y.

Despite the fact that purple-top wilt of potatoes has been known since 1915 (Muncie, 1940), the etiology of this disease has remained obscure. It was suggested by Muncie (1932), Long (1935), Orton and Hill (1938) and Leach and Decker (1938) that the disease was caused by some insect injury. Severin and Haasis (1934), Leach (1939) and Epps (1942) have shown that both eastern and western strains of the aster yellows virus may induce symptoms on potatoes closely resembling those characterizing purple-top wilt in the field. Severin (1940) transmitted the western aster yellows virus from a naturally infected, volunteer potato plant to asters by means of a long-winged strain of the aster leafhopper. This is apparently the only report of successful transmission of a virus, which resembles the aster yellows virus, from naturally infected potatoes. The western strain of the aster yellows virus is not known to occur outside of California, Oregon, Washington, Wyoming, Colorado, and Utah (Severin, 1942). For this reason it is probably not associated with the potato purple-top wilt disease as known in New York, Pennsylvania, West Virginia, North Dakota, Minnesota, Wisconsin, and Michigan. Epps (1942) reported that out of 193 trials, he obtained 28 cases of successful transmission to potatoes of the eastern aster yellows virus. He was unable to transmit the virus from potatoes to asters by means of *Macrosteles divisus* (Uhl.), but obtained transmission of the virus by means of grafts from potato to *Nicotiana rustica* L., and subsequently from *N. rustica* to asters by means of *M. divisus*.

The present studies were made in an attempt to determine more precisely the relationship between the eastern strain of the aster yellows virus and the purple-top wilt disease.

Materials and Methods

A strain of the eastern aster yellows virus was secured from naturally infected ragweed (*Ambrosia artemisiifolia* L.) found near a field of potatoes showing purple-top wilt symptoms at Gainesville, New York. Throughout these studies the virus has been maintained on asters

*The writer wishes to acknowledge the helpful suggestions and criticisms of Prof. F. M. Blodgett.

and has been transferred by means of a colony of *Macrosteles divisus* collected in the same locality.

Non-infective insects were reared on barley. When the nymphs were in the third or fourth instar they were moved to diseased asters and fed on these plants continuously for 20 to 30 days. The infective insects were then transferred to caged potato plants 1 to 1½ inches in height. At the end of the feeding period on potatoes, the cages and surviving insects were removed and the plants fumigated at 10-day intervals.

Transmission of the Eastern Aster Yellows Virus to Potatoes

During the course of these studies 475 potato plants, comprising 11 different varieties, have been inoculated with the aster yellows virus. A total of 208 or 43.8 per cent of these plants showed typical symptoms of purple-top wilt. Symptoms displayed by the varieties Rural, Katahdin, Sebago, and Mesaba are characterized by the appearance of a purple color at the base of the leaflets. Leaflets on infected plants of the varieties Warba, Earlaine No. 2, Chippewa, and Russet Burbank display a faint purpling, while symptomatic leaflets of Green Mountain, Houma and Sequoia become yellow rather than purple. The purple color appears to be accentuated by intense light in those varieties where pigmentation is characteristic. Aside from the degree and type of coloration, the symptoms on all varieties are similar. Infected plants are dwarfed, the youngest leaflets are rolled upward, and tend to be more narrow than normal leaflets. The magnitude of the angles at the leaf axils is greatly increased and shoots are produced from all but the uppermost leaf axils. During the short day seasons aerial tubers are formed in the axils of the lower leaves. From ten days to six weeks after the appearance of the symptoms the plants wilt. The roots of wilted plants are completely necrotic and the necrosis may extend a short distance upward from the base of the stem. A few tubers have been found showing a limited net necrosis at the stem end.

Attempts to transfer the aster yellows virus directly from potatoes to asters by means of *Macrosteles divisus* have been unsuccessful. Cleft grafts on *Nicotiana rustica* using scions from infected potatoes have resulted in virus transmission in less than 10 per cent of the trials. Inarch grafts have been more successful and a maximum of 50 per cent of such unions have resulted in virus transmission. Successfully inoculated *N. rustica* plants become symptomatic within 4 to 10 days and

the virus is readily transmitted from tobacco to aster by means of *M. divisus*.

Transmission of the causal agent of purple-top wilt through tubers is apparently rare under field conditions. In order to determine whether the aster yellows virus was tuber transmitted 10 small tubers were harvested from a group of Green Mountain plants artificially infected. The dormancy period was broken with ethylene chlorohydrin and the tubers planted immediately. One of the resulting plants showed symptoms typical of purple-top wilt. Approximately 150 Sebago tubers, of which 50 were aerial tubers, were harvested from naturally infected plants in the field in August. Dormancy was broken and the tubers planted in the greenhouse. All of the resulting plants appeared to be healthy.

It has been suggested that inability to demonstrate uniform tuber transmission might indicate that the resulting plants developed a form of acquired immunity similar to that reported for tobacco plants infected with the ring spot virus. Ten tubers from field-grown purple-top plants of the Sebago variety were treated to break dormancy. Half of of each tuber was planted and the resulting plants were inoculated with the aster yellows virus by means of aster leafhoppers. The remaining halves were planted and held as checks. Six of the inoculated plants became infected while all of the check plants remained healthy. These data indicated that plants from infected tubers are susceptible.

Infection Phenomena

Epps (1942) found that transmission of the eastern aster yellows virus to potatoes was erratic. Early in the present investigation similar difficulties were encountered. Accordingly, studies were made on the incidence of infection as related to the number of insects, the length of the insect feeding period, and the potato varieties involved.

TABLE 1.—*Effect of the number of insects per plant on the transmission of the aster yellows virus to potatoes.*

Number of Insects per Plant	Number Plants Inoculated	Number Plants Diseased	Percentage Diseased
5	63	24	38.1
10	63	42	66.6
20	30	21	70.0

X^2 (5 vs. 10) = 10.3 X^2 (10 vs. 20) = 0.223

Insect Number. Three experiments were conducted to determine the effect of the number of infective insects per plant on the incidence of infection. In the first two experiments plants were inoculated at the rate of 5, 10 and 20 insects per plant. The data from these two experiments have been combined. (table 1). Ten insects per plant resulted in a significantly higher percentage of infection than 5 insects per plant, but 20 insects per plant were not significantly more effective in transmitting the virus than 10. In the third experiment, plants were inoculated at the rate of 1, 2, 4, and 8 insects per plant (table 2). When

TABLE 2.—*Effect of the number of insects per plant on the transmission of the aster yellows virus to potatoes.*

Number of Insects per Plant	Number Plants Inoculated	Number Plants Diseased	Percentage Diseased
1	30	3	10.0
2	22	4	18.1
4	22	6	27.2
8	22	16	72.7

X^2 (1 vs. 2)=0.673 X^2 (2 vs. 4)=0.516
X^2 (1 vs. 4)=2.911 X^2 (4 vs. 8)=9.08

1, 2, or 4 insects were used per plant the percentages of plants infected were not significantly different, however, the trend indicated that the percentages of plants infected were in some way related to the number of insects placed on the plants. Eight insects per plant gave a highly significant increase in the number of plants infected. In parallel inoculations using individual insects on aster plants it was demonstrated that a minimum of 95 per cent of the individuals was infective.

Length of Feeding Period. It was thought that increasing the

TABLE 3.—*Effect of the length of the insect feeding period on the transmission of the aster yellows virus to potatoes.*

Length of Feeding Period	Number Plants Inoculated	Number Plants Diseased	Percentage Diseased
7 days	66	30	45.4
14 days	66	36	60.0

X^2=2.945.

period which insects fed on potatoes might be just as effective as increasing the number of insects per plant. The data from two experiments designed to test this point have been combined. These data are given in table 3. Transmission of the aster yellows virus during a 14-day feeding period was not significantly higher than during a 7-day feeding period. The mortality of *Macrosteles divisus* is high when confined on the potato. After a 14-day period most of the insects were dead and failure to secure a significant difference between the two feeding periods was probably due to the fact that a small number of insects survived to feed during the second 7-day period. Limited data have been obtained indicating that susceptibility may decrease as the plants become older. This apparent decline in susceptibility would tend to affect virus transmission during an extended feeding period.

Varietal Susceptibility. Purple-top wilt has been observed in New York more commonly on the varieties Rural and Katahdin than on Green Mountain. In view of this apparent difference in susceptibility it appeared desirable to determine the relative susceptibility of these varieties to the aster yellows virus. The combined data from two experiments are presented in table 4. A significantly higher percentage of

TABLE 4.—*Susceptibility of three potato varieties to the aster yellows virus.*

Variety	Number of Plants Inoculated	Number of Plants Diseased	Percentage Diseased
Green Mountain	52	11	21.1
Rural	52	36	69.6
Katahdin	52	40	76.9

X^2 (Katahdin vs. Green Mountain) = 32.34
X^2 (Rural vs. Green Mountain) = 24.24
X^2 (Katahdin vs. Rural) = 0.782

Katahdin and Rural plants were infected than those of Green Mountain variety. The difference in susceptibility between Katahdin and Rural was not significant. In less extensive tests involving 11 potato varieties it appeared possible to tentatively rank Sebago and Sequoia as similar in susceptibility to Katahdin and Rural, whereas Russet Burbank, Houma, Warba, Mesaba, Chippewa, and Earlaine No. 2 were similar in susceptibility to Green Mountain. These data do not agree with those presented by Burke (1941) who reported that the varieties Rural and

Green Mountain were more susceptible than Katahdin and Sebago. Burke used tuber necrosis as a criterion of susceptibility, while aerial symptoms were used in the present classification.

Virus Recovery from Naturally Infected Plants

The marked similarity between the symptoms induced by the aster yellows virus and the symptoms characterizing purple-top wilt in the field suggested that the causal agents were similar and that transmission might be obtained by similar techniques. Potato plants displaying characteristic symptoms of purple-top wilt were collected from 16 localities in New York and from two localities in Pennsylvania. Scions from these plants were grafted on *Nicotiana rustica.* A total of 198 cleft grafts were made. In four cases virus transmission to the tobacco was obtained. There were no indications that the latent virus had been transferred. This low percentage of transmission was in line with previous experience with the aster yellows virus and was further aggravated by the fact that temperatures were high and a number of scions failed to unite with the stocks. Non-infectve colonies of *Macrosteles divisus* were placed on the symptomatic *N. rustica* plants immediately. Within 10 days after the tobacco became symptomatic the plants started to wilt and after 14 days all of the tobacco plants were dead. Wilting and death are not characteristic of *N. rustica* infected with the strain of the aster yellows virus used in these studies. Three of the colonies of *M. divisus* were transferred to asters before the wilted tobacco plants died, and the inoculated asters developed symptoms typical of aster yellows. The recovered strains were designed PT-9, PT-10, and PT-14. Strains PT-9 and PT-10 originated from Katahdin and Sebago plants collected in Pennsylvania, whereas PT-14 originated from a Katahdin plant collected in New York. The symptoms induced by PT-9, PT-10, and PT-14 on asters are indistinguishable from those induced by the aster yellows virus, and the incubation periods of the different strains are the same. All of the recovered strains were transferred to potatoes where symptoms occurred similar to those induced by the aster yellows virus. All recovered strains were transferred to *N. rustica* by means of *M. divisus* and the early symptoms were identical with those caused by the aster yellows virus. Six weeks after inoculation the tobacco plants inoculated with strains PT-9 and PT-14 wilted and died, while the plants inoculated with PT-10 and the known strain of the aster yellows virus showed no symptoms of wilting 9 weeks after inoculation. The tissues in the phloem region of all plants inoculated with recovered

strains were necrotic, while the same tissues in plants inoculated with the known strain were not obviously affected. The reaction of *N. rustica* to the recovered strains may be indicative of the existence of more than one strain of the eastern aster yellows virus.

Summary

A strain of the aster yellows virus obtained from *Ambrosia artemisiifolia* was transmitted to potato and the induced symptoms were similar to those characterizing purple-top wilt in the field.

The incidence of infection on the potato was shown to be related to the number of infective insects allowed to feed on the plants.

Under controlled conditions the potato varieties Rural and Katahdin were more susceptible to the aster yellows virus than the Green Mountain variety.

A virus was transmitted by means of grafts from naturally infected potato plants displaying symptoms of purple-top wilt to *Nicotiana rustica*. The recovered virus was transmitted by means of *Macrosteles divisus* to aster, potato, and *N. rustica* and the resulting symptoms were similar to those induced by the aster yellows virus.

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TIMING APPLICATIONS FOR CONTROL OF POTATO APHIDS ON LONG ISLAND

W. A. Rawlins, R. W. Roth and J. E. Dewey

Cornell University, Ithaca, N. Y.

Potato plantings on Long Island are often heavily infested with several species of aphids, of which the pink and green potato aphid, *Macrosiphum solanifolii* (Ashm.), and the green peach aphid, *Myzus persicae* (Sulzer) are most numerous. The aphid problem has become increasingly important during recent years although efforts to control aphids have not always been profitable. Huckett (1) was unable to demonstrate yield increases large enough in many seasons to be commensurate with the cost of treatment. However, experiments of recent date (2) have been more encouraging. These experiments have shown considerable benefit from reducing aphid populations.

Of further interest to the Long Island grower is information on the number and timing of insecticide applications. This has been the objective of experiments conducted during the past three seasons in both Nassau and Suffolk counties. Difficulties have arisen in proper timing because of markedly fluctuating aphid populations that seemed to defy prediction.

Period of Aphid Infestation

The period of aphid infestation on Long Island potatoes is relatively short, usually of three weeks duration. The aphids appear in the early part of June and increase to peak population during the first week in July. Populations decrease rapidly thereafter and have virtually disappeared by the third week of July because of increased abundance of predators, parasites and disease.

In most years aphids may be expected to multiply rapidly beginning a few days previous to bloom and within a week they will have reached peak population. If rains occur at the time when aphids are most abundant, fungus disease may quickly and completely eliminate the population. During hot, dry weather insect parasites and predators accomplish the same thing. Thus the aphid population usually fluctuates markedly and is not sustained at a peak level for more than a few days. After the aphids have disappeared heavy reinfestations do not occur although the plants remain vigorous for several weeks.

Observations and records for the past six years have been used

to construct the aphid population trend illustrated in figure 1. The in-

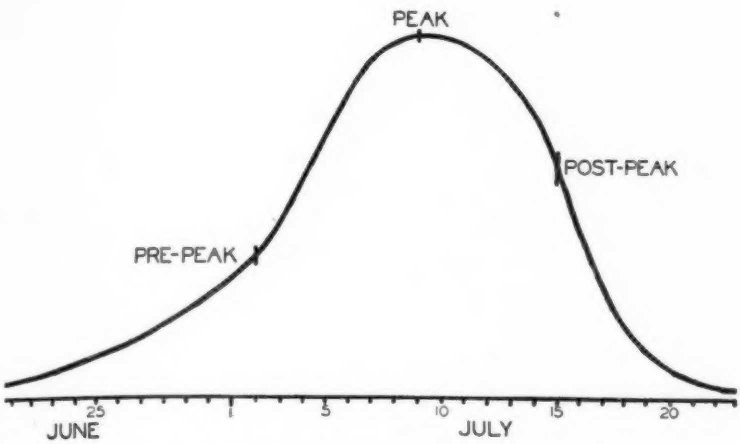

FIGURE 1.—The trend of the aphid populaton during the infestation period on Long Island potatoes and the approximate periods when insecticide treatments were applied.

tensities of population and peak occurrence have, of course, varied from year to year. Indicated on the population curve are the approximate times when insecticide applications were made to control the aphids. These applications from first to last are referred to as pre-peak, peak and post-peak. Intervals between applications were five to nine days depending upon infestations and field conditions for applying the insecticide. It was not always possible to make applications at the prescribed time.

Methods of Control Used

Three methods of aphid control were used; nicotine sulfate spray 1-400, a 3 per cent nicotine-lime dust and nicotine fumigation. Applications were made at three periods during the infestation. The experiments were designed to compare the treatments applied at one, two or all three of the periods. The fields used for the experimental work were growing Green Mountain potatoes, the late crop variety for Long Island. Growing conditions were favorable with adequate rainfall and relatively cool temperatures.

The spraying equipment delivered 120-130 gallons of spray per acre from three nozzles per row at 400 pounds pressure. The dust was applied at the rate of 35 pounds per acre by a power driven duster

equipped with a 45-foot canvas apron. The fumigated plots were treated by means of a machine* which vaporizes nicotine under a light weight 100-foot canvas trailer drawn over six rows. The product used contained 80 per cent nicotine and is specially refined for vapor fumigation.

In each experiment only one method of application was used. Therefore the various methods cannot be directly intercompared one with another. Plots were randomized in replicated blocks and treated statistically by the analysis of variance.

Aphid populations were sampled by net sweeping random areas in each plot. Final yield estimates were obtained by weighing the potatoes from a 1/100 acre strip in at least six rows of each plot.

Pronounced variations between plots in both aphid populations and tuber yields due to spotted infestation and uneven soil fertility have contributed to large experimental errors. Aphids sometimes occur in numerous localized areas of a field during the period previous to the peak in population. When they are most numerous the population is more evenly distributed over the field. Accurate sampling of the population is, therefore, difficult. Blocks of plots were necessarily large in some experiments and experimental error was accordingly increased due to soil variation. This was especially noticeable in the dust experiment conducted in 1942

Experimental Results

An extensive study was made in 1942 to determine the aphid kill and subsequent build-up after each application. Sampling of the population was made previous to and after each treatment. The results from both the dust and spray experiments are similar and data from the latter test are graphically illustrated in figure 2. Three graphs have been constructed showing the reduction in aphid populations and increase following one, two and three applications. Aphid populations are indicated on the ordinate and the period of treatment on the abscissa.

Variations in control were noted among the various applications. The first application appeared to give an unsatisfactory kill of aphids. The aphids increased slowly after the first treatment but did not reach serious proportions. Control from the second and third treatments was much better than the first treatment. Aphid populations increased slightly but

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*Loan of the equipment for the fumigation work was made possible through the courtesy of the Tobacco By-Products Co. and the Long Island Produce and Fertilizer Co. Corp. Robert Staples, U. S. A., formerly research assistant, carried on the work in 1941.

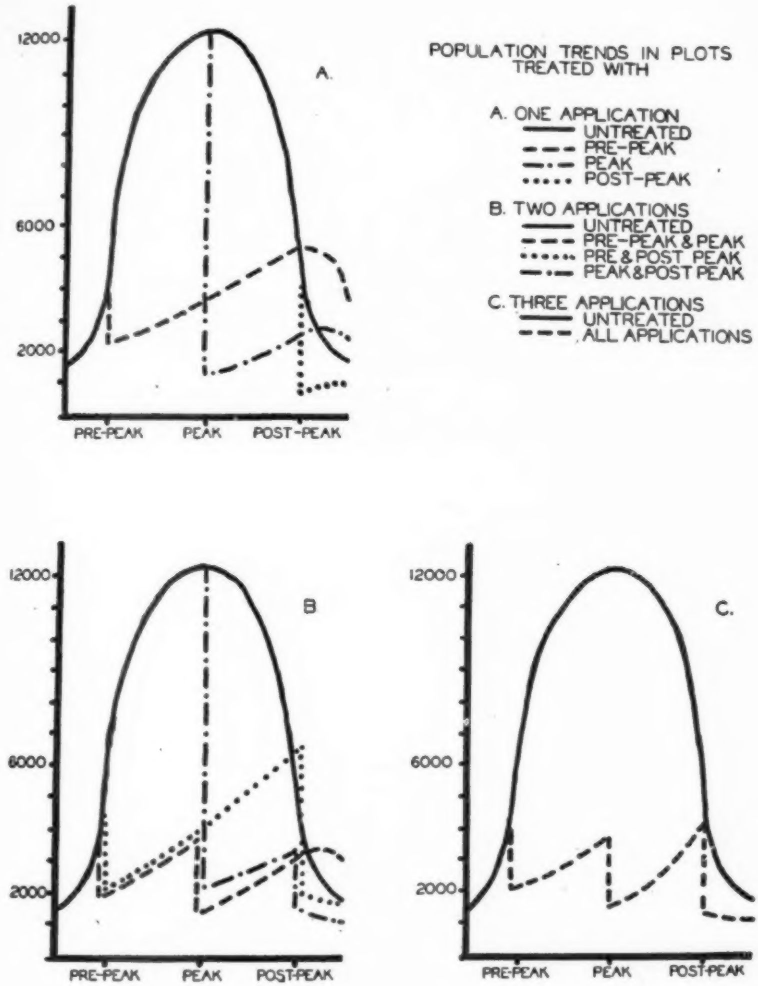

FIGURE 2.—Reduction and subsequent increase in aphid population following various insecticide applications.

declined and disappeared at the same time as the untreated populations. Three successive applications were somewhat more effective than two applications.

In the experimental plots fumigated by the Vapo-fumer the aphid population increased slightly after the fumigation application. This increase is principally due to migration of winged aphids from heavily infested plots. One application of nicotine vapor reduced the aphid popu-

lation to such a low level that a build-up did not occur during the short period of infestation.

Tuber yield data are summarized in table 1 as mean increase in

TABLE 1—*Increases in tuber yields obtained from the applications of nicotine during the aphid infestation on Long Island.*

Time of Application	Yield Increases in Bushels per Acre over the Untreated					
	1940		1941		1942	
	Vapor*	Vapor	Spray*	Dust*	Spray	Vapor
Pre-peak	—	—	—	40	33	40
Peak	59	31	22	8	20	34
Post-peak	14	13	43	21	33	37
Pre-peak, Peak	—	—	—	29	45	49
Pre-peak, Post-peak	—	—	35	57	17	—
Peak, Post-peak	50	39	—	22	31	—
Pre-peak, Peak, Post-peak	—	—	—	76	72	51
Least significant difference at 5 per cent	17	21	40	59	32	23
Yield bushels per acre of untreated plots	270	402	266	228	270	303

*Vapor = fumigation by a Vapo-fumer.
Dust = 3 per cent nicotine-lime
Spray = 1-400 nicotine sulfate

yield over untreated plots. In all cases applications of nicotine increased tuber yields but these increases were not always statistically significant.

Of the single applications no one period of treatment seemed to be more advantageous from the standpoint of yields than either of the other two periods. Two applications were not significantly better than a single application except in the case of the post-peak treatment of the 1940 experiments. A comparison of three applications with one or two treatments is limited to the past season's work. Three fumigations did not increase the tuber yields significantly more than a single fumigation. In case of the nicotine spray three applications were distinctly better than either one or two applications. Similar yield results were obtained when nicotine-lime dust was used but these differences lack statistical significance.

Summary

Aphids, chiefly *Macrosiphum solanifolii,* infest Long Island potatoes for a period of approximately three weeks during the latter part of June and until the latter part of July. Efforts have been made to determine the most advantageous times for control applications. Nicotine was used in three ways; as a spray, a dust and vapor.

Vapor fumigation was the most effective of the three methods in reducing aphid populations. High aphid kills were obtained and the population did not materially increase after application. The effectiveness of nicotine spray and dust varied according to the time of application. Previous to peak populations when the aphids were beginning to increase rapidly, the control appeared to be unsatisfactory. At the time of the peak population and later when the aphids had declined in numbers, control by both spray and dust was more effective. The aphid populations increased slowly after each application but eventually disappeared coincident with those of the untreated plots.

Increases of tuber yields were obtained from control applications. Applications may be made advantageously during a period of greatest aphid abundance. On Long Island this will be from the time immediately preceding bloom until the aphid population has declined, approximately 50 per cent. Two applications did not seem to increase yields materially over a single application. There appeared to be an advantage of using three applications in the case of nicotine spray and dust but not with the vapor.

From the data available it would appear that one application of nicotine vapor is sufficient to control aphids adequately. Control applications should be begun previous to peak populations and in the case of spray or dust more than one application may be necessary to prevent further increase in the aphid population.

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SECTIONAL NOTES

IDAHO

Idaho has planted the largest acreage of potatoes in her history with estimates varying from 160,000 to 200,000 acres. Potatoes in the early section of western Idaho will not start to market until about the twentieth of July. Both the stands and growth in this area look good after recovering from the frost experienced in mid-May. In south-central and eastern Idaho some growers experienced loss from seed rotting in the ground, and also from losses in stand and weak plants from Rhizoctonia infection. In general, however, potatoes are making favorable growth. Mr. E. R. Bennett, Extension Horticulturist, reports heavy garden plantings of potatoes in both farm and city gardens. Labor has not become a serious problem with our potato crop as yet, but the harvest season will tell the tale on this problem.

Applications for certification show nearly 4500 acres compared with 3500 in 1942. This increase in acreage applies not only to our old growers, but also to new growers. Our certified seed growers are showing more interest in foundation stocks and in the use of better stock for seed fields. (July 8).—EUGENE W. WHITMAN.

INDIANA

The movement of potatoes in the state of Indiana is not very great at the present time,—mostly local sales. The price has dropped to a reasonable amount. We are now buying potatoes for approximately \$3.50 to \$3.85 per hundred pounds. These are of fairly good quality and excellent grade. Some of the potatoes coming in from other areas are retailing for approximately \$4.50 per hundred with not too great a demand for that type of product. During the latter part of June and the first two days in July we experienced some cool weather. In the muck region of the northern part of the state there was slight damage to the potato crop and other vegetable crops but it was not serious enough to cause much of a setback or reduction in yield. We have had a lot of rain and some of the plantings were delayed. The labor situation has eased up to some extent, with the use of the school children being adequately supervised by farm managers and superintendents—using these youngsters to clean up the patches which were a bit weedy. We look for a very good crop of potatoes in Indiana.

Both the flea beetle and the leafhopper are causing some damage

in unsprayed fields, although the growers are applying control measures as soon as they possibly can. (July 7).—W. B. WARD.

LONG ISLAND

At this writing (July 9th), the potato crop on Long Island promises to be above the average. The last week in June was very hot and dry and injured the crop on the lighter fields. Just how much the crop is injured by the heat on the better fields is impossible to tell at this time. When temperatures of 90° or higher, prevail for some time the growing potatoes are undoubtedly injured.

Since the first of July we have had two adequate rains and the ground is now wet enough to carry the early crop through. The Green Mountain variety, which is by far the most important variety on Long Island, has a splendid vine growth and there should be a good crop if we can have reasonably favorable weather.

There is a little late blight scattered through most fields and the cool, wet weather is very favorable for its dissemination. Growers are spraying and dusting more thoroughly than they usually do. There is not enough blight, as yet, to do any damage. Aphids have made their appearance in many of the fields, but if the cool, wet weather continues we do not look for any serious injury from that source.

The crop, on the whole, is at least ten days later than usual but harvesting operations have started in some of the sections where the growers are planning to put in a second crop following the potatoes. Yields are running from 75 to 90 hundred-pound bags per acre. These potatoes should have at least an additional ten days before being harvested which would very materially increase the yield and improve the size which is now running pretty small. (July 9).—H. R. TALMAGE.

MICHIGAN

Planting was completed about a week later than usual. Weather conditions have been very favorable so far. Some fields of the early planting were lost entirely, and some of the remaining fields show poor stands. The stands in the late plantings are apparently good.

Our growers still have their fingers crossed concerning the labor situation. It seems as though more women and children are doing field work today than ever before.

The inspection of certified seed potatoes will begin about the 20th of July. Indications show that there will be only a slight increase in

the certified seed acreage compared with that of last year. (July 7).—H. A. Reiley.

MINNESOTA

We have had what might be called a hectic spring. Potato planting in the sand land area started off well in April and the moisture has been sufficient to bring the crop along in excellent shape, although the rainfall and cool weather did interfere slightly with other crops,—especially those in the market garden areas in the vicinity of the Twin Cities. Potatoes from this region will be on the market by the time the July issue of the Journal is published.

The growers on peat in the southern part of the state and also in the Princeton-Aitkin area suffered rather severe losses because of excessive rainfall. Forty per cent loss in onions and potatoes is estimated at Hollandale. At Aitkin one grower lost 200 acres of potatoes when the Mississippi River overflowed its banks and made a lake of his potato field.

In the Red River Valley conditions varied. Planting generally starts in this area about the 10th of May and is usually completed before the 10th of June. Intermittent rains prolonged planting in certain parts of the Valley until the first week in July. Low temperatures in early fall will not help these late plantings. The farmers in this area have had quite an uphill struggle to plant the acreage requested by the Federal Government. Had reasonably good conditions prevailed, they would easily have gone over the top. Considerable acreages of grain and potatoes have been destroyed, but with good growing conditions during the summer, the harvest is not going to be much below that of last year.

Unfavorable conditions have made it impossible for many growers to get in their applications for inspection by the 15th of June and we had to extend the time limit because of the inability of growers to know just how many acres they would have to be certified. Practically all applications are in now and a little hasty adding indicates that the acreage entered for certification is about 25 per cent above the acreage entered in 1942. Checking over these applications it is quite evident that, in general, the seed stock planted should produce some excellent seed of all important varieties. (July 12).—A. G. Tolaas.

NEBRASKA

The main crop, which is grown in the western Nebraska high land

area, was planted from a week to ten days later than usual. The final plantings were made about the 1st of July. Our delay in planting was occasioned by a rainy period during the middle of June. Because of this delay in the middle of the period, there is a spread in the planting,— the earliest potatoes having been planted during the first week in June, and the balance, during the last two weeks.

Generally speaking, conditions are very favorable over this western potato territory. An occasional grower reports seed piece decay. The exact cause has not been determined, though improper handling after seed treatment, and proper storage, seem to be the common cause.

The acreage planted is only slightly greater than that of 1942, whereas the Government had requested a 15 per cent increase. The unfortunate labor situation that existed in 1942, together with the low temperature in September discouraged growers from increasing their acreage this year.

The acreage of potatoes being entered for certification is approximately the same as in 1942, which was 15 per cent below the 1941 crop.

There is a marked shortage of labor throughout most of the territory, though it is not quite so complicated as it was a year ago. At that time, a number of defense plants were being constructed, and it resulted in disrupting the entire labor picture. It is possible that additional labor may be secured for the harvest, by having men released from local war plants, army camps, prison camps, or relocation centers housing Japanese-Americans. All of these sources are being tapped for all available labor. A number of Japanese-American families were moved into the territory this spring, as regular farm laborers, and will be here throughout the season.

The difficulty in getting repairs for machinery or new equipment is probably as serious a complication as the labor situation. This is particularly true with the potato crop, which is grown practically 100 per cent with mechanical equipment. If the labor-saving equipment could be made available, it would relieve the labor shortage materially.

The early potato crop in Nebraska, centered around Comstock-Arcadia, and around Gibbon-Kearney, in the eastern end of the state, is reaching maturity at this time. Harvesting will begin, in some cases, within a week or ten days. Late blight has been reported in this territory for the second consecutive year. This season, however, unfavorable weather has checked it, so that little damage should result. The disease was first located in fields in which the seed was known to be infected. The territory ships in all of its seed from points outside of

Nebraska. The varieties used are, at present, not grown in the state as seed potatoes. (July 14).—MARX KOEHNKE.

NEW JERSEY

The harvesting of potatoes on New Jersey's largest acreage since 1923, has been started, in a very limited way, in Central Jersey. A few fields of very immature Cobblers are being harvested with yields averaging about 100 sacks per acre. Wet fields, together with a slow demand, have caused a light digging to date. The quality is generally good but the tubers are quite muddy and skinned up in most offerings, resulting in a rather poor general appearance.

Farmers are receiving only $2.25 to $2.35 per 100 pounds. This price is not a great inducement for harvesting at present, since most fields will increase in yield from 15 to 25 per cent if allowed to mature, and a price of $2.20 is guaranteed throughout the season.

Recent rains, from the 27th of June through the 15th of July, have been scattered with most areas receiving sufficient moisture to insure good growth for another week. Crop prospects are fair. Katahdins have set very poorly in many fields, and aphids have caused severe damage in some areas. Corn borers have been particularly serious this year. High temperatures, together with a high humidity have favored a widespread bacterial decay in the vines. As a result of these factors there will undoubtedly be some low yields in the late varieties. (July 16).—J. C. CAMPBELL.

SOUTH CAROLINA

Potato harvest was completed about the 20th of June in this area. For some growers, unless the labor, machinery, and price situation radically change, it is probably completed for several years to come. Some growers are in the potato-growing business and can't readily change to other crops because of soil or other reasons, so they will probably continue to grow potatoes. Others can quit or shift to other crops and probably will plant no potatoes or a greatly reduced acreage. So it is impossible to predict the acreage of potatoes for next season. Then, too, as planting time approaches next winter, the potato-growing urge will no doubt infect many of the growers.

The I. C. C. restriction on the icing of potato cars during early June came at the most inopportune time and caused the South Carolina potato growers to lose, according to some reports, nearly $100,000.

The hottest weather for early June in many decades prevailed in this area at the peak of potato harvest. Daily maximum temperatures during the period from the 1st to the 7th of June, respectively, were 97, 95, 98, 99, 105, 102, and 94. Potatoes were heated in the field during harvesting for they could not be taken from the fields rapidly enough because of a shortage of available manpower. And, it takes *man* power and not women and children to handle bags of potatoes. The potatoes for the most part were not graded but were sold as Victory pack which included No. 1's, 2's, 3's, culls, a few rotten ones and what have you. It was necessary for most growers to sell their potatoes as Victory pack because not enough men could be found to operate graders. In addition to these factors, the price was approximately as much as Victory pack as for graded U. S. No. 1, Size A. Well, the hot potatoes went into hot cars and the soft rot bacteria made the most of their opportunity. As a result, it can be imagined that the noses at the terminal markets know of the approaching arrival of some cars of South Carolina potatoes several miles before they were seen. If the potatoes had been allowed to cool overnight and been placed in cool cars and given one initial icing, the problem of rotting in transit, no doubt, would have been reduced to a minimum.

Another cause for dissatisfaction among growers was the ordering by the government officials that certain cars be shipped to certain Army camps with the freight prepaid, and good condition arrival guaranteed. For a large grower with financial backing, the situation was not so serious as for a small grower. For instance, one grower grew three cars of potatoes. Two cars were shipped through ordinary channels and the receipts used to pay the cost of production and harvesting. The receipts from the third car were to enable the grower to pay his other family expenditures and for his living expenses during the following months. But the third car of potatoes was ordered to be shipped prepaid to an army camp in Connecticut. The grower did not have the several hundred dollars to pay the shipping charges and did not want to take the risk of shipping the cars without ice to such a distant market at \$2.65 or \$2.70 delivered (if in good condition) when he could sell it for \$2.85 close by. Then, too, he could get his money promptly in case of the latter type of transaction whereas if it were shipped to the army camp in Connecticut, he was probably out his freight charges and pay for the car for several months. In case the shipment reached the destination in bad condition, who was to take the loss? Naturally, as always, the grower! Furthermore, on what was the grower's family to live and what was he to use in starting his fall truck crops? Why

should the grower have to run all the risks (including three freezes) of growing the crop and then have to assume all the risks of getting the product to the customer?

No late blight or ring rot could be found in this area during the past season. Early blight was prevalent in some fields that were severely damaged by low temperatures. It was present in most fields during the harvest period, but was of very minor importance. Black leg-infected plants could be found in most fields, but were generally less than 0.1 per cent. Scab was not so serious as in 1942. Rhizoctonia was about as usual, being present in most fields, but did not cause much damage in any planting. Leafroll was probably the most prevalent and serious virus disease, ranging from 0 to 30 per cent with different seed lots. *Sclerotium rolfsii* killed nearly all plants in the lighter soils in some fields. Brown rot or Southern bacterial wilt was prevalent in a few fields and decaying of some of the immature tubers had already occurred several weeks prior to harvest. Root knot was very severe in some fields, 100 per cent of the tubers being affected. Root-knot infested tubers were severely knotted at the lenticels. Some varieties appeared to be more severely affected than others.

Katahdin and Pontiac performed better than other varieties during the past season. Pontiac was outstanding in yield but did not carry so well in transit. Irish Cobbler appeared to recover from the effect of the three cold periods in March and April less readily than did Katahdin. Sequoia was very late. After the damage caused by low temperature it did not set tubers until nearly harvest time. In addition, some tubers of Sequoia had sprouts or secondary tubers at the apical eyes. Sebago did not appear very promising. Indications are that in 1944 there will be a considerable increase in the acreage of Katahdin and Pontiac, providing the seed are available and not too expensive. (July 13).—C. N. CLAYTON.

NEW YORK

The Federal crop estimates for July indicate a 6 per cent increase in the New York crop for 1943 as compared with 1942. This estimate may be fairly well in line with recent reports from leading growers in various parts of the state. As recent as the 10th of July reports from six leading potato growers, including Long Island, eastern, northern and western New York, indicated that the potato acreage was increased about 15 per cent compared with that of last year. Because of the lateness of the planting season, and in many localities too much rainfall for proper preparation of the fields, the final yield per acre is likely to

be below normal. In fact the 15 per cent acreage increase may well result in a crop not more than 6 per cent of that of 1942. In every section of New York the crop was finally planted from a week to three weeks later than normal. Although the quality of the seed used on Long Island was probably as fully as good as normal, this was not at all true upstate. Many growers lost considerable seed from rot between cutting and planting time. For the same reason many of the fields show poor and uneven stands.

The early crop on Long Island, harvest of which usually begins during the early part of July, was somewhat reduced by the hot, dry weather during the latter part of June. H. J. Simonson, a leading grower in Nassau County, Long Island, estimates a reduction of 25 per cent in the early crop on this account. However, since the 1st of July rains have been fairly general throughout the state with the result that excellent growth is being made at the present time. (July 14).—E. V. HARDENBURG.

NORTH CAROLINA

Harvesting of Irish potatoes will be practically completed in Eastern North Carolina by the 17th of July. There may be a few growers who will have offerings the first part of the week of the 18th. This has been one of the most hectic seasons ever experienced by growers in the early belt.

Despite the fact that the potatoes in many fields were frozen twice, the quality of the crop was excellent for the most part and the yields were much better than expected. Two large growers stated that they had the best crop they had ever grown notwithstanding adverse seasonal conditions in the early part of the growing season.

Many things have happened to complicate the situation since the last report on the 15th of June. In the early part of the season most of the potatoes moved at ceiling prices, but the market soon broke and the Food Distribution Administration began buying at floor prices. On the first of July, the F.D.A. announced that it could not buy any more potatoes because funds allocated for this purpose had been exhausted. However, they began buying again on the 3d of July with the provision that all potatoes must have had a curing or skin toughening period of 48 hours before they would be accepted. Even though this provision might have been highly desirable, it was thoroughly impractical for our growers who were not prepared to carry it out. This restriction was finally removed after much inconvenience to the growers. Cars would not be placed unless they could be loaded and

moved within 24 hours. It was obvious that unless potatoes could be moved by truck, digging would have to be slowed up. The 48-hour curing period threw many potatoes out of grade and complicated a situation which was already bad enough. The permit to ship requirement was finally removed, and towards the end of the season potatoes were moving mostly at floor prices with heavy offerings to F.D.A.

The labor situation has been bad and some convicts have been used in certain counties. Some persons have been indicted for labor "pirating."

The government woefully underestimated the potato acreage in Eastern North Carolina for 1943 because goals were reached and exceeded,—an outcome evidently not expected by Washington. Much of the acreage increase above the established goals was due to the fact that many farmers who had not grown potatoes before planted a rather large acreage this year. Many of them used land which was not suitable and this coupled with inexperience caused a number of them to leave potatoes in the ground or plow them up. These farmers acted in good faith. They were motivated both by patriotism and the prospect of a good market.

Another thing growers could not understand was why Virginia should be moving potatoes at ceiling prices while no market existed for North Carolina potatoes. There were some diseases in certain areas, and also some rough handling which led to breakdown in transit, but these two factors were not sufficient to explain the conditions the growers had to face this year.

We hope that we will never experience another season similar to the one just passed, and with the pressure brought to bear on Washington by growers and others, we think that a more orderly procedure will be worked out for us another year. (July 15).—M. E. GARDNER.

OHIO

The early potato crop looks fairly good. There has been some water damage and the vines are generally smaller than usual. Fair yields are expected. The crops planted early, about the first of April, look better than those planted later. A few potatoes are now being harvested along the Ohio River, but the volume has been too small to establish prices. Harvesting operations will increase and be fairly heavy until the latter part of July.

The late crop prospects are exceptionally poor. Heavy rains resulted in the loss of large acreages,—especially the fields planted during

the latter part of May and the first part of June. Other acreages show poor stands. Some of the late acreage was not planted until the last week of June. We will need a late season if these crops are to mature. Our growers are concerned about the labor situation, especially since the crop will be harvested during the late fall,—after school begins. It is hoped that some labor will be imported for the potato harvesting. (July 14).—E. B. Tussing.

PENNSYLVANIA

Although potatoes are planted throughout most of the state, our plantings were very late and our stands are poor. Our spraying operations are being started and the scarcity of spray machinery is being felt.

Late blight was reported from Lehigh and Clarion counties on the 21st and 23d of June, respectively. The early appearance of blight emphasizes the necessity of a good spraying job this year. (July 5).—O. D. Burke.

Late blight has been reported in Pennsylvania. Weather conditions in most sections of the state, however, have not been favoable for the disease since the last report was made. Although there have been scattered showers, most areas have had a deficiency in rainfall. It was quite dry and hot during the latter part of June. Since that time, moisture has been sufficient, but not abundant,—in most potato-growing areas.

The stands in the northern-tier counties are not so good as in the southeastern area.

Inspections for seed certification have already been started. Disease counts are running quite low, which indicates very little spread of the virus diseases during the 1942 growing season. Rhizoctonia appears to be quite serious in some fields and may be the cause of some of the poor stands. Seed-piece rot was apparently the cause of most of our poor stands.

The early potatoes in the southeastern counties have set well and with normal rainfall, should produce a good crop. (July 9).—K. W. Lauer.

VERMONT

Vermont's increase in potato acreage is now estimated at 30 to 40 per cent above that of last year. Approximately 12,000 acres was the figure for 1942. Although planting operations were generally late, good growing conditions have made up for this to a large extent. No late blight had been reported to date,—the 12th of July.

Enrollment for seed certification appears to show a corresponding increase presumably due in part, at least, to the hectic seed situation prevailing this spring. The trend away from Green Mountains toward Katahdins and Houmas has continued, although Green Mountains are still the predominating variety.

Much concern exists regarding handling and marketing of the crop this fall in view of the promised government purchasing program. It is questioned whether adequate storage facilities will be available. (July 12).—H. L. Bailey.

VIRGINIA

The potato harvest in Virginia is about two weeks later than usual. Ordinarily by the 10th of July most of the Virginia crop has moved to market. This year by the 10th we have only moved about one-half of the crop. Eastern Shore has moved 3772 cars and Norfolk 1518 cars. This late movement has been caused by the late development of the crop and the shortage of labor, cars and trucks and also the heavy movement south of here which tended to hold up Virginia shipments.

Conditions on the Eastern Shore have been ideal for harvesting this year. The Eastern Shore area, which is the peninsula lying between the Chesapeake Bay and the Atlantic Ocean, has been favored with excellent weather conditions for harvesting the crop, which has thus far moved to market in excellent condition. During the first two weeks of the harvest, the Eastern Shore crop was selling at ceiling price at loading points, whereas the crop farther south was selling below ceiling or was being purchased at a support price by W.F.A. Yields on the Eastern Shore from Eastville south were heavy,—averaging about 150 bags per acre. In some sections the high temperatures and the lack of rainfall during June greatly reduced the yield. At the Virginia Truck Experiment Station, at Onley, the total rainfall from the 1st of June to date has been less than two inches and all crops in that area are suffering from moisture deficiency. The average yields for the entire shore will be above 100 bags per acre. Most of the Eastern Shore growers will at least break even on their crop but only

those who were favored with the best weather conditions which were conductive to high yields will make a fair profit. Prices are now declining and there is a possibility that part of the crop will move at the support price of $2.25 provided it can be harvested before it rots in the field. In the Norfolk area the picture is very dark. Excessive rainfall during the past ten days has delayed digging and it is likely that the losses from rot in the heavily flooded areas will be very heavy. Most of the shipments this week have been purchased at support price by the W.F.A. It is feared that much of the acreage still unharvested will either rot in the field or fail to make U. S. No. 1 grade and not be eligible for W.F.A. purchase at a support price. In general, the growers will lose heavily even if weather conditions improve in the near future. The condition in North Carolina is similar to that of the Norfolk area. A large acreage between Elizabeth City and Norfolk still remains in the field. The late maturity of the North Carolina crop brought North Carolina and Virginia potatoes in the market simultaneously and there were more potatoes than the public could consume during this period. This caused a further delay in harvesting. Had it not been for W.F.A. purchases at support price the market would have collapsed during the latter part of June. Just what will happen to the market during the next two weeks is problematical. Labor throughout the area has been relatively scarce but still there has been sufficient to harvest more potatoes than the civilian and the armed forces could consume. In the Norfolk area the Navy furnished more than 400 men each day. This was also supplemented with Bahamian Negro labor brought north from Florida. (July 16).—H. H. ZIMMERLEY.

WASHINGTON

We have had a rather backward spring in Washington this year, because of cool temperatures and excessive cloudy weather and rains.

Despite this condition, however, the potato crop at the present time looks very promising. The acreage of certified seed planted is nearly double that of 1942, which is more nearly normal than it has been for a period of years,—last year being exceptionally low so far as acreage is concerned.

The majority of our White Rose seed potatoes have been contracted for sale but we have no information concerning price. This latter probably will depend somewhat upon the OPA decision.

Our labor supply is our most acute problem because of war industries on the Pacific Coast, together with enlistments in the military

forces, and also the drafting of our young men for military service. Generally speaking, however, our seed potato growers have kept their acreage within the limits so that the crop may receive proper care with the labor supply that is available. (July 6).—CHAS. D. GAINES.

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YIELD, SPECIFIC GRAVITY, AND STARCH CONTENT OF TUBERS IN A POTATO BREEDING PROGRAM

ROBERT V. AKELEY[1] AND F. J. STEVENSON[1]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, Washington, D. C.

Varieties of potatoes differ from one another in a number of characters, among which are yield, specific gravity, and starch content of their tubers. A few American varieties have reached a high standard in yielding ability, but they are poor in other respects. Some are not adapted to a wide range of conditions, and where they are not adapted they produce low yields and second growths, resulting in tubers of poor market quality.

Yield, like any other genetic character, is the result of heredity and environment working together. A variety may be potentially a high yielder from the standpoint of its heredity, but if the environment is not right it will not yield to capacity. Green Mountain, for example, yields well in the most favorable locations in the New England States, in parts of New York State, and in a few other locations but is quite unreliable in the western or southern sections of the United States. The Russet Burbank is successfully grown under some of the best growing conditions in a number of western states, but under adverse conditions it is especially susceptible to second growth, resulting in low yields of U. S. No. 1 tubers.

[1]Assistant plant breeder and senior geneticist, respectively.

The Irish Cobbler, on the other hand, is remarkable for its adaptability, producing satisfactory yields under a wide range of conditions. The same can be said for Katahdin, a variety that yields well in nearly all the potato-growing sections of the United States, in Argentina, in Uruguay, and even in parts of South Africa and Australia. Sequoia, although it has not been so widely grown, has outyielded Katahdin in comparative tests and seems to be widely adapted.

The specific gravity or relative density of a tuber is largely dependent on the percentage of its solids or dry-matter content. If the tuber is high in solids and low in water content, the density will be high, and *vice versa.* Since the greatest part of the solids in the potato is starch, there is a high correlation between specific gravity and starch content, and it is possible to estimate one from the other with a fair degree of accuracy.

Materials and Methods

The parent material used in the breeding program has been secured from various parts of the world. The present American varieties are depended upon to contribute high yield, desirable tuber shape, and resistance to the three virus diseases, mild mosaic, latent mosaic, and vein banding. Latent mosaic resistance may have come originally from South America. The European varieties have shown high starch content, yellow flesh, and resistance to common scab, late blight, potato wart, and leaf roll. A species immune to late blight and resistant to leafhoppers has been obtained from Mexico. From Russia a number of varieties have been received with a degree of resistance to frost injury. If most of these characters can be combined in one variety, it will take much of the drudgery and cost out of potato growing and reduce many of the huge losses that occur at present.

After parents are assembled they are tested for all the important characters. Those that prove superior in one or more characters are planted in early January in the greenhouse at the Bureau of Plant Industry Station, Beltsville, Maryland. Most varieties will not bloom under the ordinary short day of winter, but by the use of artificial lights to supplement the natural daylight to provide at least a 16-hour day, they are induced to bloom freely. A relatively large number of crosses are made, and whenever possible the parents are self-pollinated. Fruits and seed are produced. The seed is planted in August, and the plants are grown to maturity in the greenhouse and harvested in December. In

recent years approximately 30,000 seedlings have been grown annually. About 80 per cent of these produce tubers large enough to plant in the field. Most of these are taken in the spring to the new experimental farm at Chapman, Maine, to be grown for increase; the others are sent to a number of cooperating state experiment stations.

At harvest time thousands of the seedlings at Chapman are discarded on sight. They may show low yielding ability, poor shape deep-eyed tubers, too late maturity, or other undesirable characters. Those that are selected are planted in 10-hill rows at Chapman and in various disease-resistant tests on Aroostook Farm or on adjacent farms. The survivors and others that show characters superior to the standard varieties are tested for yield, specific gravity, and cooking quality.

In the yield test the seedlings with standard varieties for checks are planted in six replications of 25-hill rows in randomized blocks. The hills are planted 14 inches apart and the rows 34 inches. At harvest time the tubers are graded into two classes, U. S. No. 1 size and culls, and weighed. The data are analyzed statistically. A difference between the means of two varieties that is twice its standard error or more is considered significant. Samples are taken from each replicate for specific gravity tests. In the earlier studies tuber density was determined by comparing the weight in air with the weight in water. Recently, however, it has been obtained by a simpler method reported by Haddock and Blood (*2*) and independently by Clark *et al* (*1*). The tubers are floated in table-salt solutions of known density. Twelve such solutions with densities varying from 1.060 to 1.115 at intervals of 0.005 are used. Tubers are considered to have the same specific gravity as the solution in which they will barely float. A total of 60 to 120 tubers of each variety has been found to be an adequate sample for Maine-grown material.

Specific gravity readings are changed to starch content by the use of a table that gives the equivalents for these two characters. These equivalents are means and consequently are subject to variation, but in studying a large number of varieties and seedlings they are considered accurate enough for comparative purposes. The yield of starch per acre is computed by multiplying the total yield per acre of a given variety expressed in pounds by its percentage of starch.

Results

Yields. So far no seedling resulting from selfing a variety has

yielded as much as the parent, although some of them are nearly as prolific. For example, several seedlings of Katahdin selfed have approached that variety in yielding ability. Some crosses produce high-yielding seedlings, others comparatively low-yielding ones; or, in the language of the animal breeder, some crosses "nick" well, others do not.

In the study of the yielding ability of seedlings from a given cross, 109 selections of Chippewa x Katahdin, which are themselves sister-

TABLE 1—*Yield data for 25 seedling potatoes from a cross between Chippewa and Katahdin grown at Presque Isle, Maine, for three years. Two standard varieties, the parents, and one grandparent (seedling No. 24642) were tested for comparison.*

Varieties and Seedlings	Yield per Acre of U. S. No. 1 Tubers 1932	1933	1934	3-year Average	Percentage of U. S. No. 1 Tubers 3-year Average
	Bushels	Bushels	Bushels	Bushels	Per cent
Green Mountain	358	233	435	342	90.0
Rural New Yorker	350	183	395	309	90.9
Katahdin	383	105	445	341	90.5
Chippewa	392	204	487	361	87.4
Seedling No. 24642	317	93	375	262	77.1
" 44481	242	86	384	237	79.0
" 488	433	243	504	393	92.0
" 489	258	107	325	230	75.4
" 491	458	243	448	383	92.3
" 492	358	161	366	295	86.3
" 496	333	127	368	276	89.6
" 503	367	150	445	321	84.0
" 504	483	252	549	428	93.7
" 508	167	98	403	223	69.5
" 510	275	95	383	251	76.8
" 511	383	118	485	329	81.2
" 512	317	88	283	229	82.7
" 515	425	183	572	393	89.1
" 520	433	205	475	371	92.1
" 523	425	233	542	400	89.1
" 529	325	191	494	337	83.4
" 537	275	77	344	232	77.1
" 549	408	178	470	352	83.4
" 550	450	243	606	433	91.5
" 559	433	271	480	395	90.8
" 562	358	193	436	329	85.0
" 564	325	203	527	352	85.2
" 584	383	233	424	347	93.3
" 586	300	186	384	290	91.2
" 596	333	214	416	321	88.4

brother seedling varieties, were compared in 1932 for yield with their parents and with one of their grandparents, seedling No. 24642. Chippewa yielded 392 bushels of U. S. No. 1 potatoes, Katahdin 383, and seedling No. 24642 yielded 317. Four of the 109 seedlings gave significantly higher yields than either parent; 6 higher than Katahdin; and 51 higher than seedling No. 24642. Twenty-five of these selections were retested in 1933 and in 1934. The yield data for this group in bushels per acre of U. S. No. 1 tubers are given in table 1.

Two of the seedlings, No. 44504 and No. 44550, yielded significantly higher than either of the parents, Chippewa and Katahdin; 7 higher than Katahdin; and 9 lower than either parent. Seventeen yielded higher than the grandparent, seedling No. 24642; but none of them significantly lower. The data show that transgressive inheritance resulting in hybrid vigor is operative even when parents heterozygous for a number of characters are used.

One of the higher yielding selections of this progeny, seedling No. 44488, was found to be resistant to mild mosaic, moderately resistant to late blight, and more resistant to scab than Green Mountain. It was given further tests, increased, named Sebago, and distributed to growers in 1938. According to a report by the United States Department of Agriculture, more than 900,000 bushels of certified seed of this variety were produced in 1942.

The yield data for certain American varieties and seedlings for the last 4 years and for European varieties for the last 2 years are given in table 2.

Sequoia was the only late variety that yielded significantly higher than Green Mountain. Pontiac, Earlaine 2, and Mohawk were in the same class as Green Mountain, but the others were significantly lower. Among the early varieties Irish Cobbler, Warba, and Red Warba were not significantly different. Irish Cobbler, however, outyielded Triumph, Mesaba, Earlaine, and seedling No. 46952. The last was in the class with Triumph, Warba, Mesaba, and Earlaine from 1940 to 1942. This seedling is resistant to ring rot and is very early in maturity. None of the European varieties approached the Green Mountain checks in yield or in the percentage of U. S. No. 1 tubers. Ackersegen was the highest yielder of the European group. In fact, it yielded about the same as Katahdin for an average of the 2 years it was under test.

TABLE 2.—*Yield data for certain American late or early varieties and for European varieties of potato grown at Presque Isle, Maine, 1939-42.*

Varieties	Yield of U. S. No. 1 Tubers per Acre					U. S. No. 1 Tubers Compared with Total
	1939	1940	1941	1942	4-Year Average	
	Bushels	Bushels	Bushels	Bushels	Bushels	Per cent
Late varieties						
Green Mountain	195	337	429	273	309	91
Katahdin	135	237	356	216	238	85
Chippewa	192	276	369	233	268	86
Houma	165	323	343	200	258	84
Sebago	197	260	376	197	258	90
Sequoia	224	378	415	324	335	91
Mohawk	222	251	450	229	288	95
Earlaine 2	226	303	460	269	315	91
Pontiac	224	350	396	284	314	90
Erie	141	251	394	216	251	79
Pawnee	...	...	387	231	...	96
Norkota	...	...	374	...	...	95
White Rose	...	...	...	222	...	90
47452	...	...	275	125	...	86
245-186	...	...	331	...	...	97
245-229	...	...	335	...	...	93
528-118	...	...	383	...	...	96
627-164	...	...	304	...	...	78
2 x standard error of difference	37	40	50	40	21	
Early varieties						
Irish Cobbler	185	247	381	196	252	86
Triumph	172	172	315	151	203	85
Warba	203	225	360	167	239	85
Red Warba	197	250	356	201	251	85
Mesaba	106	194	301	168	192	79
Earlaine	197	215	331	179	231	87
46952	...	206	304	165	...	97
2 x standard error of difference	37	35	33	23	16	
European varieties					2-Year Average	
Popular			90	36	63	35
Ostbote			270	108	189	62
Record			270	206	238	84
Mittlefrühe			298	164	231	75
Frühegold			263	136	200	74
Voran			270	181	226	74
Matador			222	136	179	83
Ackersegen			393	183	288	83
To-be-identified			210	110	160	58
Parnassia			88	...	...	79
Eigenheimer			...	93	...	68
Triumph			...	62	...	76
Iduna			...	101	...	68
Starkeragis			...	137	...	72
Erdgold			...	135	...	60
Prisca			...	165	...	72
Ultimus			...	89	...	51
Green Mountain (check)			441	237	339	95
2 x standard error of difference			43	35	28	

TABLE 3—*Distribution according to tuber density classes of potato seedlings from three crosses. Grown at Presque Isle, Maine.*

Parentage of Progeny	Character	Seedlings in Density Classes[1]									Total Seed-lings
		1	2	3	4	5	6	7	8	9	
		No.	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
Chippewa x Katahdin[2]	Specific Gravity	1	6	16	24	36	14	6	0	0	103
336-123 x 47156[3]	"	0	1	8	18	19	18	10	8	0	82
336-123 x Earlaine[3]	"	1	1	4	2	15	9	4	1	0	37

[1]Density classes based on approximate specific gravity determinations, with starch equivalents.

[2]A difference in specific gravity between seedlings of this cross amounting to 0.010, or two class intervals, is significant by odds of 300:1.

[3]A difference between seedlings of these two crosses amounting to one class interval is significant by odds of better than 100:1.

Specific gravity. The specific gravity of tubers is conditioned, like yield and other characters, by genetic factors. It is, however, greatly influenced also by the factors of environment. The influence of heredity is shown in the wide differences between sibs (sisters and brothers) grown side by side in the same field. Three progenies of crosses grown at Presque Isle, Maine, have been tested for density on the basis of specific gravity determinations. The data for these tests are given in table 3.

Density Class No.	Specific Gravity	Starch Equivalent Per cent
1	1.060	9.5
2	1.065	10.7
3	1.070	11.7
4	1.075	12.9
5	1.080	13.9
6	1.085	14.9
7	1.090	16.1
8	1.095	17.2
9	1.100	18.2
10	1.105	19.3
11	1.110	20.3
12	1.115	21.4

Although tubers of the same seedling differed considerably in density, certain of the differences between seedlings of the same progeny were highly significant. In the cross of Chippewa x Katahdin the odds were better than 300:1 that a difference between seedlings of 0.010 in specific gravity, or two class intervals, was significant, and in the other two progenies a difference of 0.005, or one class interval, was highly significant. If differences of two class intervals are due to soil variation or other factors of environment, differences greater than this amount can be considered due to genetic segregation. On this basis the sibs of these progenies are inherently different in tuber density, since some of them differ by as much as six class intervals.

Relatively large differences in density of tubers of the same variety occur even when they are grown in the same field. The differences are still greater when the same variety is grown in different locations. In 1942 samples of 16 varieties were obtained from different parts of the country. These were tested for tuber density. A summary of the results is given in table 4.

TABLE 4—*Tuber density of 16 potato varieties grown in various parts of the country in 1942. The data are given as the mean of density class values[1] for three samples of each variety for each place.[2]*

Variety	Maine	Pa.	Idaho	Michigan		Wash.	Colo.
	Presque Isle	State College	Aberdeen	Rogers City	Lake City	Puyallup	Greeley
Katahdin	7.2	3.1	8.5	5.5	5.6	4.3	5.6
Sebago	7.8	2.6	7.5	6.9	...	7.0	...
Irish Cobbler	7.4	3.7	6.3	6.4	5.2	...	...
Chippewa	5.3	1.9	7.0	4.3	3.5	...	...
Green Mountain	9.8	5.7	...	7.5	...	...	...
Sequoia	9.4	3.8	...	...	...	5.2	...
Houma	8.2	3.1	8.1	...	...	...	...
Warba	7.4	2.7	...	...	...	...	...
Earlaine 2	3.9	1.5	...	...	...	...	...
Pontiac	7.1	...	7.0	...	2.4	4.5	...
Triumph	5.8	...	6.2	...	...	...	6.1
White Rose	7.4	...	...	...	...	8.9	...
Russet Rural	...	4.0	...	6.2	5.9	...	...
Rural New Yorker	...	2.8	...	...	...	...	5.8
Russet Burbank	...	...	7.5	...	...	4.7	...
Pawnee	...	...	...	...	...	...	6.6
Significance at 5-per cent level	0.5	0.7	0.5	0.6	0.6	0.7	1.14
Significance at 1-per cent level	0.6	0.9	0.7	0.9	0.8	1.0	1.58

[1]See footnote 1, table 3, for density classes and equivalents in specific gravity and starch.
[2]Six samples of each variety from Greeley, Colo.

Katahdin grown in 7 locations showed wide extremes in mean tuber-density class values from 3.1 to 8.5, a highly significant difference. Another highly significant difference between states is shown by the 9 varieties that were grown at Presque Isle, Maine, and in Pennsylvania. The differences between the means of the samples of each variety for the two locations are highly significant as is also the difference between the two locations, if all 9 varieties are considered as a group. The Maine samples showed on the average a very much higher density than the samples from Pennsylvania.

The tuber-density class means of three samples each of Katahdin, Sebago, Irish Cobbler, and Chippewa, grown at four widely separated stations are given in table 5. There is no significant difference between

TABLE 5—*The average tuber-density class values*[1] *of three 20-tuber samples of four varieties of potatoes grown in four different states.*

Variety	Location of Tests				Variety Mean[2]
	Idaho	Maine	Michigan	Pennsylvania	
Katahdin	8.5	7.3	5.5	3.1	6.1
Sebago	7.5	7.5	6.9	2.6	6.1
Irish Cobbler	6.3	7.3	6.4	3.7	5.9
Chippewa	7.0	4.9	4.3	1.9	4.5
Location mean[3]	7.3	6.8	5.8	2.8	...

[1]See footnote 1, table 3, for density classes.

[2]Difference required for significance at 5-per cent point, 0.4; at 1-per cent point, 0.5.

[3]Difference required for significance at 5-per cent point, 0.4; at 1 per cent point, 0.5. Interaction between varieties and locations exceeded the 1-per cent level.

the means of Katahdin, Sebago, and Irish Cobbler, but there is a highly significant difference between these three varieties and Chippewa. There was a significant difference also between any two means for stations. The mean for Idaho was higher than that for Maine; Maine higher than Michigan; and Michigan higher than Pennsylvania. The interaction between variety and location was highly significant also, indicating that the varieties did not rank in the same order at all stations. Katahdin, for example, was significantly higher than Sebago in Idaho and Pennsylvania. They were about equal in Maine, but Sebago was significantly higher than Katahdin in Michigan. Chippewa exceeded Irish Cobbler in Idaho, but the reverse was true in the other three locations.

When a definitely measurable character, such as tuber density, varies so greatly in response to environmental conditions it is little wonder that a variety may be quite satisfactory in one place and unsatisfactory in another; or, in other words, one variety is not equally adapted to all combinations of environmental factors. It is remarkable that varieties such as Katahdin and Irish Cobbler are so widely adapted.

Starch content. Since starch content in these studies is calculated from specific gravity, everything that has been said about the latter can be applied to the former. Inherent differences between seedlings in the same progeny as well as between progenies and between varieties have been found. Relatively large differences are found also between tubers of a variety grown in different parts of the same field, and extremely large differences when grown at widely separated stations.

Starch production. The better grades of potatoes grown in this country are used principally for human food; the poorer grades for stock feed and by-products, the latter mostly starch. The Europeans, on the other hand, grow large acreages of potatoes especially for the manufacture of starch, dextrins, alcohol, and other products.

For the past two years a number of American varieties have been compared for starch content and total yield with one another and with several "so-called" high starch-producing varieties from Europe. The data for these tests are given in table 6.

The two-year averages for the American late varieties show that there was no significant difference in percentage of starch content between Green Mountain and Mohawk. The three next best were Sequoia, Sebago, and Houma, followed by Katahdin, Pontiac, Chippewa, and Earlaine 2, in the order named. As a group the early varieties were lower than were the late in starch content. Irish Cobbler had about the same percentage as Katahdin but was significantly lower than Green Mountain and Mohawk.

Among the European varieties tested for two years Popular Ostbote, Record, and To-Be-Identified were significantly higher in percentage of starch than the Green Mountain check, and among those that were tested for only one year Starkeragis was significantly higher than Green Mountain.

When the calculated yields of starch per acre are compared, however, Green Mountain surpassed all the others, but is not significantly higher than the two American varieties Sequoia and Mohawk nor the European variety Ackersegen. The Irish Cobbler, which is the most

TABLE 6—*Starch content of American and European varieties of potatoes; total yield of tubers per acre, and calculated starch yield per acre,*

Varieties	Starch Content[1]			Total Yield of Tubers Per Acre			Starch Yield Per Acre[2]		
	1941	1942	2-Year Mean	1941	1942	2-Year Mean	1941	1942	2-Year Mean
	Per cent	Per cent	Per cent	Bushels	Bushels	Bushels	Pounds	Pounds	Pounds
American Late Varieties									
Green Mountain	18.6	19.1	18.9	447	292	370	4,988	3,346	4,167
Katahdin	16.8	16.3	16.6	380	229	305	3,830	2,240	3,035
Chippewa	14.0	14.2	14.1	401	253	327	3,368	2,156	2,762
Houma	16.6	17.4	17.0	404	224	314	4,024	2,339	3,182
Sebago	17.6	17.0	17.3	410	217	314	4,330	2,213	3,272
Sequoia	16.4	18.6	17.4	425	329	377	4,182	3,671	3,927
Mohawk	18.9	18.7	18.8	460	236	348	5,216	2,648	3,932
Earlaine 2	12.4	12.8	12.6	489	279	384	3,638	2,143	2,891
Pontiac	14.9	16.2	15.6	411	300	356	3,674	2,916	3,295
Erie	15.3	....	....	422	246	334	3,874	....	....
Pawnee	15.3	....	....	403	243	323	3,700	....	....
Norkota	16.1	....	....	394	...	...	3,806	....	....
White Rose	....	16.5	....	....	246	...	....	2,435	....
47452	17.7	....	....	297	...	...	3,154	....	....
245-186	18.1	....	....	340	...	...	3,692	....	....
245-229	19.0	....	....	361	...	...	4,115	....	....
528-118	16.5	....	....	399	...	...	3,950	....	....
627-164	17.5	....	....	387	...	...	4,064	....	....
2 x standard error of difference	0.8	0.7	0.6	50	37	31	489	373	309
American Early Varieties									
Irish Cobbler	16.6	16.5	16.6	410	214	312	4,084	2,119	3,102
Triumph	14.6	14.7	14.7	336	183	260	2,944	1,614	2,279
Warba	15.5	16.5	16.0	371	193	282	3,451	1,911	2,681
Red Warba	15.9	16.6	16.3	372	231	302	3,549	2,301	2,925
Mesaba	16.5	....	....	325	201	263	3,218	....	....
Earlaine	14.4	....	....	367	200	284	3,171	....	....
46592	12.5	13.5	13.0	307	174	241	2,303	1,409	1,856
2 x standard error of difference	0.5	0.5	0.4	34	22	20	206	205	180

TABLE 6—*Continued*

Varieties	Starch Content[1]			Total Yield of Tubers Per Acre			Starch Yield Per Acre[2]		
	1941	1942	2-Year Mean	1941	1942	2-Year Mean	1941	1942	2-Year Mean
	Per cent	Per cent	Per cent	Bushels	Bushels	Bushels	Pounds	Pounds	Pounds
European Varieties									
Popular	20.3	19.9	20.1	220	125	173	2,680	1,493	2,087
Ostbote	20.6	21.6	21.1	385	203	294	4,759	2,631	3,695
Record	20.3	20.5	20.4	327	246	287	3,983	3,026	3,505
Mittlefrühe	18.4	18.1	18.3	372	236	304	4,107	2,563	3,335
Frühegold	15.1	15.3	15.2	332	201	267	3,008	1,845	2,427
Voran	19.9	18.3	19.1	385	231	308	4,597	2,536	3,567
Matador	19.7	19.6	19.7	267	167	217	3,156	1,964	2,560
Ackersegen	18.0	19.5	18.8	438	243	341	4,730	2,843	3,787
To-be-identified	20.7	19.4	20.1	365	193	279	4,534	2,246	3,390
Eigenheimer	....	18.1	....	...	136	...	....	1,477	....
Triumph	....	16.0	....	...	82	...	....	787	....
Iduna	....	18.9	....	...	149	...	....	1,690	....
Starkeragis	....	21.6	....	...	192	...	....	2,488	....
Erdgold	....	18.1	....	...	225	...	....	2,444	....
Prisca	....	19.2	....	...	231	...	....	2,661	....
Ultimus	....	19.6	....	...	175	...	....	2,058	....
Green Mountain (check)	19.2	19.0	19.1	460	256	358	5,299	2,918	4,109
2 x standard error of difference	0.7	1.0	0.6	48	41	32	541	455	359

[1]Starch was determined from the specific gravity of the tubers (see footnote 1 of table 3).

[2]Starch yield per acre was calculated by multiplying the total yield per acre in pounds by the respective percentages of starch content.

widely grown of the early varieties, and the Katahdin, which is becoming the most widely grown of the late varieties, were significantly lower in yield of starch per acre than Green Mountain, Mohawk, or Sequoia, or the five European varieties Ostbote, Record, Voran, Ackersegen, or To-Be-Identified.

Discussion

In the potato breeding work at present, yield, market quality, and density of tuber are given major consideration, the last because of its close relation to cooking quality and starch content. Varieties and seedlings are inherently different from one another. This can be determined best when they are grown under similar conditions. Wide differences are found in the same variety when grown in different parts of the country. A variety may yield 500 bushels or more per acre in one location and 100 or less in another. Some tuber characters, such as depth of eye, shape, and color are fairly constant, but tuber density, and its related characters, cooking quality and starch content, are quite variable. The density of tubers of a single variety grown in one location may differ very greatly from the density of tubers of the same variety grown in another place, and the cooking quality may vary from poor to excellent.

When the war interfered with the importation of potato starch from Europe, production in this country was greatly increased. If the war continues, the potato may be used not only as a source of this commodity but as an important source of other by-products, such as dextrin, sugar, alcohol, and synthetic rubber, all of which have been manufactured from potatoes in European countries.

It has been a common belief that the so-called "high starch" varieties of Europe are much superior to ours for the production of starch. Some of these have been brought to this country and compared with American varieties in tuber yield, starch content, and starch yield. It is evident that although a number of foreign sorts showed a higher starch content than some of the best American varieties the high yields of tubers of the latter resulted in a higher yield of starch per acre than for any of the European varieties, except possibly Ackersegen. Ackersegen has yellow flesh, is very late maturing, and has tubers of relatively low market quality. Since the potato crop in the United States is used largely for human food and the by-products are manufactured from off-grades and culls, Ackersegen would be undesirable in comparison with many of the

American varieties. However, some of the European types that show high starch content will be used as parents in an effort to combine this character with the high yield and high market quality of the American varieties.

Summary

The yielding ability of 109 seedlings from the cross of Chippewa by Katahdin, a sister-brother cross, was compared with that of their parents and of one grandparent. The data show that the transgressive inheritance resulting in hybrid vigor is operative even when parents heterozygous for a number of characters are used. The Sebago variety is a selection from this cross.

In variety yield tests in Maine from 1939 to 1942, Sequoia was the only late variety to give significantly higher yields than Green Mountain. Pontiac, Earlaine 2, and Mohawk were in the same class with Green Mountain. Among the early varieties, Irish Cobbler, Warba, and Red Warba are similar in yields. Ackersegen was the highest yielder of the European varieties, and over a two-year period was comparable to Katahdin in the production of U. S. No. 1 tubers.

Genetic segregation for tuber density was evident when the comparisons of sibs were made within three family lines. Environmental conditions affected tuber density to a high degree, a variety grown in one location differing very greatly from the same variety grown in another place.

A few European varieties were higher in percentage of starch content than the American varieties tested, but when total yields per acre were taken into consideration several American varieties outyielded all of them with the exception of one of the European varieties in the calculated production of starch per acre. This foreign variety is very unsatisfactory in other characters. It has yellow flesh, a low yield of U. S. No. 1 tubers per acre, is too late in maturing, and has low market quality.

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POTATOES IN MEXICO[1]

John Tucker[2]

Department of Agriculture, Ottawa, Canada

The idea that a few impressions following a short visit to farms in Mexico in 1942 combined with some general information and opinions expressed by agriculturists there, might be of interest, prompted this brief article.

The wonderful agricultural resources and possibilities of Mexico are, as yet, only partially developed. Of the 490 million acres comprising the Republic, about 350 million may be classified under the heading of agricultural lands. These represent areas suitable for cultivation, grazing and pasture lands, timber tracts, etc. Of this area, only about 20 million acres are at present under active cultivation.

There are probably no soils with greater productive possibilities than the rich alluvial deposits, loam, sand, clay, marsh and swamp lands that are to be found in Mexico. Some of the farms there, especially those in the thickly settled communities, have actually been producing good crops for hundreds of years without the application of any commercial fertilizers, and are still doing so, but the need for the addition of organic matter to obviate so much irrigation is obvious now on many of these long faultily tilled farms.

The impression in the minds of many that Mexico has only a hot, unhealthy climate is a mistaken one. There are really three climates there, tropical, temperate and cold. There are considerable tropical areas along the coastal region and especially to the south but there are also sections of perpetual snow with areas of temperate and semi-tropical climate between. It is not possible to define the limits of these areas but it is generally accepted that the tropical climate extends from the coast to an altitude of approximately 3,000 feet. In this region the average temperature is around 85° F., while the extreme temperature is about 105° F. All the vegetation in this area is truly tropical. The temperate zone lies between the altitude of 3,000 and 6,000 feet, with an average temperature ranging about 75° F. This is the general agricultural section of the country and with the overlapping of the tropical

[1]Contribution No. 33 from Plant Protection Division, Science Service, Dept. of Agriculture Ottawa, Canada.
[2]Chief Inspector, Plant Diseases.

and cold climates at the edges a wide range of products is possible within a limited area. Here are found the rich valley lands of the greatest agricultural production of the country. The so-called cold climate extends above 6,000 feet, and in the agricultural sections of this zone the temperature averages around 60° F., but may drop to 20° F. or lower during cold weather. Snow flurries are not uncommon. Beyond the agricultural sections lie mountain peaks. The country, as a whole, can therefore be considered as healthy as any and in some sections is unrivalled in that respect.

Two distinct seasons are recognized in Mexico,—the dry and the rainy season. The dry season is from November to May inclusive and the rainy season from June to October. However, there are localities in the tropical areas where rainfall is extended throughout the year and there are large areas in the north with scanty rainfall and desert conditions. The first impression one gets on entering the country by road or by rail from the United States is that desert conditions predominate, but agreeable surprises await the traveller the further he goes into this unforgettable country, tempered possibly by some that may be interesting but not so agreeable.

There is, in fact, such a wide range of soils and climatic conditions that practically anything, from the oak and pine of the highlands to the Mahogany, Ebony, Mango and Papaya of the tropics; from the apple of the cold areas to all the fruits of the temperate zone down to the most tender fruits of the tropics; from coffee beans and cocoa to rubber; from wheat to rice; and all the vegetables from A to Z; can be grown successfully somewhere there, and all may be obtained within a short day's travel, in some districts.

The three principal crops are corn, beans and wheat, and account for about one-half the total cultivated area. Sweet potatoes are also popular with the Mexicans. Irish potatoes have never become so popular there, as in the United States, Canada, or Europe. They are more costly and are considered somewhat of a luxury. They appear regularly on the tables of foreigners and in many of the restaurants but are not much in evidence in Mexican homes. Strangely enough, the potato or "papa" as it is called there, does not appear in the official lists of primary cultivations for the country, which is something of a paradox seeing the wild potato is indigenous to the country. However, Mexican Indians and the Spanish infiltrations since the conquest have always been consumers of corn and beans rather than potatoes. Nevertheless, the growing of

Irish potatoes has been on the increase in recent years for production advanced from approximately 1⅓ million bushels in 1925 to more than 2½ million bushels in 1938. Importations in 1938 were about 73,360 bushels, about one-half of which was from Germany and Denmark,—the rest from the U. S. A. These are understood to have been used principally for seed purposes although it is difficult to ascertain this point as Mexican statistics include both seed and table stock under one item. Present imports are believed to be about 60,000 bushels annually, practically all from the U. S. A. and mostly for seed purposes.

The average price of local grown table potatoes at the farms range from about one to two cents per pound. The retail prices in the cities range from two to four cents per pound, figured in U. S. currency, at present exchange rates. Potatoes are sold on a commercial graded basis. The grades are "Extra," "De Primera" and "De Segunda." Grade Extra specifies potatoes of uniform size and colour, free from rots, bruises and sprouts. Grade "De Primera" tolerates potatoes bearing sprouts and bruises and allows some variations in sizes. Grade "De Segunda" permits a percentage of culls not allowed in the other grades.

Notwithstanding the favorable factors of rich soil and suitable climate; the abundance of rock phosphate, Guano, and limestone, at present practically unexploited; and in many areas plentiful supplies of water for irrigation; the yield of potatoes is disappointingly low. A yield of 60-75 bushels per acre is considered a fair crop with 125 bushels per acre considered exceptionally good.

After observing the large top growth of the plants in some areas, the low yields were astonishing. The chief reasons for the average low yields appear to be due to the fairly general use of degenerated seed; diseases and insect pests which in the absence of suitable control measures wreck havoc with the crop; shallow seed beds; the lack of humus in the soil, and indifferent cultivation practices. The reasons for the large tops, it was suggested, is due to the altitude at which the potatoes are grown. There are wide variations in temperatures in rarified atmospheres. The vegetation and soil surface are greatly heated by the sun during the day but the air remains cool. It feels very hot in the sunshine but cold in the shade. The nights are cold and the soil cools very rapidly after sundown. A luxuriant growth of tops results, but the root system and tuber growth appear small and out of balance with the large top growth.

On many of the farms, the subsoil is unbelievably hard, actually beyond the capacity of modern farm machinery to handle, which means that with the use of antique straight-pointed plows drawn by oxen, the method still in vogue on most farms, production is limited to the few inches of surface soil. These soils are capable of improvement with proper soiling practices but the value of humus and rotations does not appear to be generally understood, or at least applied, by farmers. This is possibly because with very limited funds for agricultural development work, all long term crop improvement programs, on such relatively unimportant crops as Irish potatoes in that country are not considered as vital to the needs of the country as are others,—such as rubber at this time.

The most modern machinery and methods known to science are employed freely, in the exploitation of the mineral and oil wealth of the country, but only occasionally are modern implements and practices seen in agricultural operations. Primitive methods and implements are principally used in the growing of potatoes, with hand labor, which is plentiful and cheap, for all other operations.

The planting is generally done by hand. A furrow is opened up by the plow and a hole dug for the set by one man with a hoe or azadon as it is called. Another man drops and covers the set. From 10-18 bushels of small whole, usually ungraded, seed are used per acre. Fertilizers are not used at all in some districts and, in others, only sparingly, because of the high costs. Where used, the fertilizer is dropped with the seed set.

The varieties both local grown and from imported seed are numerous. There are apparently quite a number of native wild and of cultivated varieties of the *Solanum demissum* species referred to as "Criollas." The native varieties are considered best adapted to local ecological conditions but apparently no complete data on their origin exists. They are all late varieties having a longer growing period than those of the imported *Solanum tuberosum* species. The principal native varieties appear to be the Criolla, Amarilla, Shato, Morada, Pinta, Chata and Blanca. The name "Criolla" is sometimes used in a general sense for all native cultivated varieties, and sometimes reserved for the variety Amarilla. The Amarilla is the most popular variety grown. It has a smooth skin, is round with deep eyes, and is pink in color, with yellow flesh. It has a growing period, roughly speaking, of 150 days.

The leading imported varieties that are grown are: Bliss Triumph,

Green Mountain, Rural New Yorker, Brown Beauty, Downing, Pearl, British Queen, Up-to-date, Majestic, Eda, *Magnum Bonum,* Sport, Richter's Imperator, Edelragis, Schneeragis, Ratweisragis, Wekaragis, Konsuragis. The countries of origin of these importations are fairly obvious.

Imported potatoes are first grown on the high cooler lands for one or two years for multiplication purposes and are then planted in the lower and warmer areas for table purposes. The yields are heavier on the low lands but are of poorer quality and grade. They are retained for growing on the low lands until they cease to yield satisfactory crops.

Incidentally, samples having been sent from Canada to Mexico, at the request of cooperatives there, an effort was made to find out what had been accomplished with them. The samples had been distributed by the cooperatives to growers who were supposed to decide their economic value from the standpoint of yield, and also by the number of plantings that varieties continued to yield good crops under the present production methods. It was learned that the original plantings had been examined by officials who found all the plots remarkably free from diseases and of excellent vigor. Some excellent yields had been secured in some districts but returns were not so good in others where late planting and killing frosts were admittedly responsible for smaller yields. Most of the operators intimated that the potatoes had done extremely well. However, some disappointment was expressed that the imported varieties do not continue to produce large yields or maintain their original vigor and freedom from diseases for very long. One lot had produced five successive crops in two years by being moved around from cool to warm climates and back again, but the yield was reported to be no better than that obtained from native varieties at the final planting. No complete records of the yields were kept. It was doubted if varieties which degenerated quickly would become popular with the growers there.

These haphazard experiments have had value in leading to the appointment of an agricultural engineer to start potato projects in 1942 on an experimental farm established in the State of Leon for that purpose. However, the fear was expressed that the policies and the work of the Department change so quickly that satisfactory long term experiments necessary to secure the desired results might end prematurely. There is no doubt of the need for improvement work in all operations connected with potato production. It appears to be a virgin field for

specialized improvement work and progress should be rapid with the information now available. The native varieties are obviously running out and the country may have to depend more and more on importations of seed to maintain home-grown supplies for the two million of the nineteen million inhabitants now using Irish potatoes.

The cost and availability of suitable seed are considered major problems of growers at this time. Good seed is far away, expensive, and somewhat scarce. One development since imports from Europe have been cut off is the importation of so-called "seconds" or small potatoes from the winter crop of some of the Southern States, for use as seed potatoes. Trial imports of certified seed from Northern States have recently been made and will likely prove more satisfactory from the standpoint of quality, but high rail transportation costs may prove prohibitive to the development of a large seed business between these distant points, especially after the war when shipping is again available to carry cargoes to the Gulf ports of Tampico and Veracruz. For the present, anyway, Mexico appears to be a fair prospect for those favorably situated to best supply her needs of good seed at reasonable cost. Friendly guidance leading to better production methods would also be welcomed there.

Keen interest is evident in new varieties, especially if samples can be secured gratis. It appears very doubtful, however, if the distribution of free samples will lead to more than the requests for more samples. Samples sent on a commercial basis through reliable seed concerns is apparently a more desirable way of developing business. Shipments should be well crated and wire-bound if possible. Otherwise the loss may be heavy due to sampling en route. New varieties have a strong appeal to the growers in that region, an affinity exists in that respect, apparently, between all potato men. Hope springs eternal that some day pest control and other complex production problems may be solved in an easy way for the grower, namely; through the introduction of high-yielding resistant varieties of good quality. When this is accomplished, and with the abundant natural resources and suitable environmental conditions there, potato growing in Mexico should indeed become most profitable.

SECTIONAL NOTES

CALIFORNIA

While talking to a wholesale grocer today, I was told that in canned goods every one demands fancy products.

He said after all the "Fancies" were gone, he could then sell some "Standard" grades, and after all the "Standards" were sold, one could then sell some sub-standard varieties. It is believed that the same situation exists in perishables.

At the present time there is a very heavy demand for the best U. S. No. 1 Size A potatoes, and, in fact, this demand for fancy washed California Long Whites comes in from all sections of the country.

At the same time, in many localities their own native potatoes are going begging and the government has taken over a great many cars.

What's the answer?

It seems to lie in the large amount of spending money—or purchasing power. People cannot buy automobiles, refrigerators or build new houses; so therefore they are spending their money for food, and the best is none too good.

I imagine this tendency will continue for the duration, because despite bond drives or forced savings—there is still too much spending money.

A meeting was supposed to be held last Tuesday, in Washington, in connection with the Support Program of the Department of Agriculture as far as central and northern California is concerned. We have not, as yet, heard the results.

I believe this Support Program should be extended, as at the present time it only provides a support price on U. S. No. 1 and Commercials—85 per cent U. S. No. 1 or better—grades.

The Support Program seems to be needed for the lower grades. (Aug. 10).—E. Marx.

COLORADO

Colorado is experiencing an unusual summer. The spring was dry and windy without the usual spring moisture. The temperatures have been unusually high. All stands, in general, over the state are poor, and plant growth is considerably behind that of last year. Despite an increased acreage it now appears doubtful that Colorado will ship as many potatoes as were shipped in 1942.

The early districts of the state have been shipping since the latter part of July, and good yields are being obtained. The Fruita district is the earliest district in the state, and so far shipments are ahead of last year. In the Gilcrest section, although free from late blight this year,—for the first time in two years,—is producing an excellent quality. Shipments in this section are also above those of last season. The Olathe district in Montrose County on the western slope will start shipping about the fifteenth of August, and will have the best crop in several years.

The annual San Luis Valley Field Day was held on the 5th of August. At this meeting the growers had an opportunity to study the experimental work in progress.

A new potato district is coming into production this year at Wiggins, in Morgan County. All the potatoes in this district are being irrigated from wells, and it is apparent that the district has a promising future for quality potato production on the sandy type of soil which is found there.

The certified seed acreage is above last year's, and the first inspection has been completed. Our inspectors report excellent quality as a result of the indexing tuber unit and the foundation seed program which is now in full operation for the first time. (Aug. 13).—C. H. METZGER.

CONNECTICUT

In general, the precipitation during the months of June and July have been lower than usual, and in many cases the yield of potatoes has been reduced by the unfavorable climatic conditions. Aphids were very abundant during the latter half of July and it was necessary to use drastic spraying methods to control them. Nevertheless, most of the commercial growers have fair prospects for average yields in 1943. (Aug. 10).—B. A. BROWN.

IDAHO

A recent trip across the state gives us a fair cross section of the situation in Idaho at this time. The former reports of increased acreage were well founded. It is my opinion that the potato crop in Idaho does not show so good prospects at this time as it did a year ago. New growers, marginal land and poor seed are showing their effects on a considerable acreage, whereas a cold, wet planting season combined with rhizoctonia infection has resulted in poor stands and weak plants

in many fields. This does not mean that there are not many good fields of potatoes but that these conditions are prevalent enough to have some effect. In general, the crop is somewhat later than usual.

Prices for early Bliss Triumph stocks in the Caldwell area started out at ceiling for the first few cars but soon dropped, and marketing has been dull. Apparently no support price has been set for early potatoes in Idaho. Dealers, in general, throughout the state are pessimistic about the prices.

A considerable volume of new storage is being built both by dealers and individual farmers in anticipation of the greater total volume of potatoes which will undoubtedly be produced. Growers are beginning to show some alarm concerning machinery and labor. Some interest has been shown in methods of hastening maturity as a means of spreading available labor and machinery over a wider harvest period. Requests have also been received for information on emergency storage for potatoes.

A rather severe frost in the higher altitude sections of eastern Idaho did not damage the certified seed areas as much as was anticipated at first. Although many fields suffered some injury, many of the areas escaped with little damage. An increase of approximately 1,000 acres to a total of 4,500 acres of seed has been entered for inspection. (Aug. 6).—EUGENE W. WHITMAN.

LONG ISLAND

The Long Island farmers have been digging potatoes freely. Many growers have completed the harvesting of Cobblers and are now starting to move the Chippewas. The Green Mountains are still green and it will be ten days or, perhaps, more before they will be mature enough to dig.

The early potatoes have yielded as well as average. All reports indicate that the Green Mountain crop will be light. There does not appear to be any specific reason for the light crop, unless it was injured beyond recovery by the very hot temperatures that prevailed during the latter part of June.

On the "South Side," which usually produces about one-third of the Suffolk County crop, the yield promises to be very light, because of a severe infestation of aphis and dry weather.

Although Long Island has a larger acreage than last season it is doubtful if we shall send as many potatoes to market from this season's crop. (Aug. 13).—H. R. TALMAGE.

MAINE

We are facing a big crop the country over, and Maine in particular has evidently done its part. Many are saying that never in their memory has the potato crop looked so good at the middle of August.

Our plantings have reached nearly two hundred thousands acres, based on AAA figures. This acreage is somewhat in excess of Crop Reporting Service acreage, but they should be more accurate. For the first time in many years blight has not been prevalent at this date, the 14th of August. Even in spots that have not been sprayed at all there is no blight present. It is even difficult to find many dead leaves. A year ago today the crop showed many brown leaves. The present condition, therefore, means late harvesting, and the scarcity of labor will mean quite a struggle, if we wish to get it taken care of before freezing weather.

Storage is at a premium. Growers are frantically trying to get permits for storage construction, or in the event permits have been approved, to get labor and lumber with which to build. Many are using the old-fashioned method of digging a hole in the ground on the farm, putting up cedar posts and capping it all with an inexpensive roof. This emergency building will be very helpful to relieve the pressure, but it is doubtful now if under the best of conditions, we will have enough storage room.

Large chain buyers and some independents are taking advantage of this confusion and lack of sufficient storage to buy at considerably less than the support price of $1.90 per cwt., f.o.b., would justify. The most common trading levels vary from $2.00 to $2.25 per barrel, whereas the support price as announced should justify at least $2.65 per barrel. Also, these buyers are denying storage to growers, who have for the most part, in previous seasons, stored them in their houses. This makes growers panicky and enables buyers to keep prices depressed.

That action should be taken early, goes without saying. Tangible evidences of government support are decidedly lacking, which adds to the uncertainty and confusion. A program should have been announced weeks ago. It is getting almost too late to be of any psychological benefit.

If growers are to keep confidence in governmental promises, real evidence must be found soon that "floor prices" mean what they say.

The acreage of certified seed has been heavier than ever, covering

well above fifty-two thousand acres. There is apparently a big rejection of acres entered, caused by diseases,—amounting to about 40 per cent. There will be more on second inspection and still others will be denied approval at harvest time because of ring-rot. We expect we shall have sufficient seed to meet regular demands, at least, but there is some question whether there will be seed enough for the acreage intended next year. (Aug. 14).—FRANK W. HUSSEY.

MICHIGAN

In general, our potatoes are in good condition. Rainy periods have occurred at the right time to maintain good growth. The stands, as a whole are below normal; however, vine growth is much better than normal.

Our first inspection of certified seed is nearly completed at present. Rejections, because of diseases in fields of certified seed, are few. As yet, there is no evidence of any damage from blight.

Harvesting in the early producing section is well under way. The quality, in general, is fair. The yields from our early harvest are finding a home mostly within the state,—with prices slightly above the floor price. (Aug. 13).—H. A. REILEY.

NEBRASKA

The most important news on Nebraska potatoes is that crop conditions continue to be reasonably favorable. Most dry land areas in western Nebraska have received rain when needed, though at this writing, additional rainfall is necessary. Although the ground conditions were good at the time of planting, many of the fields produced poor stands, because of seed piece rotting. This apparently was due to poor storage conditions prior to planting. These poor stands are a common complaint, in both the dry land and the irrigated sections.

Inspection for certification is well under way,—the first inspection being practically completed, and some second field inspections are being performed. The acreage entered for seed certification is about the same as last year,—approximately 9,000 acres.

The High Plains Potato Conference which has been held in previous years, and cancelled during 1942, will meet again this year. The meeting will be held at Scottsbluff on the 14th of August. Many of the potato workers from Wyoming, Colorado, and Nebraska will be present.

(A report of the results of this meeting will be submitted later.) (Aug. 12.)—MARX KOEHNKE.

NEW JERSEY

The New Jersey potato crop is reaching peak movement. Most of the Cobblers and Chippewas have been dug and many growers are now harvesting Katahdins.

The government's support of floor prices has been disappointing to date, especially regarding No. 2's. Growers have been getting about 75 cents per 100 pounds, whereas the government support price is $1.32. Very few cars have been purchased to support the price but it is expected that larger purchases will be made soon.

The government purchase of 75 cars for seed purposes has begun, as well as some additional cars for table stock. These purchases should help the present price slump.

Our growers have recently been receiving $2.05 to $2.10 per 100 pounds, whereas the support price is $2.25 f.o.b. For this reason our growers are anxious to have the government keep its word in connection with support prices.

Demand at present is only fair, since most shipments are being made to the central west, the south and New England.

Our yields are somewhat below those of last year. The latest crop report places our yield at 169 bushels per acre. However, our quality is, in general, very good. (Aug. 16).—J. C. CAMPBELL.

NEW YORK

The estimate of the first of August of the New York potato crop is 30,879,000 bushels or 6 per cent above that for the 1st of July. This increase is probably predicated on fairly good growing weather and well distributed rainfall during the month. However, many growers do not think this increase is justified. Stands are quite generally poor, and insect pests have been more abundant than normal. Long Island has suffered from lack of rain, and late blight is very generally present throughout the state. Although blight has done very little damage to date, the lateness of planting, recent rains and cool nights combine to indicate that it may be serious before the crop is in storage. Much emphasis is being placed on the spray and dust program.

This year the number of custom spray rings in New York was more than doubled. There are 33 of these in operation as against 15

last year, the acreage involved being more than 7,500. These spray rings are serving about 1,300 growers, the average acreage for each being about six. In addition to the 8 counties now having custom spray rings, seven other counties have applied for this service next year.

New York growers are bitterly opposed to the proposal of the government to roll back potato prices this fall and subsidize the grower in order that the consumer may pay less for potatoes. The increased acreage was planted on the promise of a definite support price program. Any change at this time will seriously shake the confidence of producers in future government proposals.

Several carlots of new, immature potatoes have been shipped into New York from the South for canning and for market. These potatoes were loaded without refrigeration and as a result were in bad condition on arrival. The damage is caused by brown rot, a bacterial soft rot always present in new, immature potatoes shipped under hot, humid conditions with insufficient icing. This is another case of bungling.

With other states, New York has established a standard for "War Approved Seed Potatoes." It permits a maximum of not more than 5 per cent leaf roll or mosaic and not more than 7 per cent total of all virus diseases. It is too late to read virus in many fields, hence the program cannot be very effective except as it applies to certain fields which do not quite meet the standard for certified seed.

Three potato field days have been scheduled for the month of August. Steuben County will hold its annual summer potato field day at Cohocton on the 16th of August. Steuben County is New York's biggest producer, aside from Long Island. Within the last four years, growers from Maine, Long Island, Connecticut, and New Jersey have moved into this county and are now producing about 1,000,000 bushels from approximately 16,000 acres of our best potato soil. Perhaps the biggest potato storage in the East is located at Avoca in Steuben County. With the addition now under construction, its capacity will approximate 350,000 bushels. The Empire State Potato Club has arranged two regional field meetings in western and central New York. One of these will be held on the muck farm of Porter and Bonney at Elba in Genesee County on the 25th of August. The other meeting will be held at Gardner Farms, Tully, New York, near Syracuse on the 26th of August. Both of these will be afternoon meetings and are principally designed to enable the potato growers to become better acquainted with O.P.A. potato price regulations. There is a strong feeling that many

growers lost money last year because they were not able to interpret properly allowable markups and differentials. Those interested in having these matters cleared up should attend these meetings. (Aug. 16). —E. V. HARDENBURG.

The acreage of potatoes entered for inspection for certification this year in New York State is about 3,800. This represents about a 50 per cent increase compared with that of 1942, which in itself was an increase of about 13 per cent compared with the previous year. The weather at planting time was very unfavorable, resulting in late planting of many fields and very poor stands in some of the others. Since then, however, growing conditions have been favorable and although yields may not be so large as those of the last three years, they will probably be satisfactory.

Plans are just being perfected for dealing with the new, war approved seed authorized by the Office of Price Administration and the War Food Administration. Many of us, both growers and inspectors, are not very enthusiastic about this plan for the following reasons:

1. Without more information regarding the need for increased seed, it would seem that increases already made in the certification work should take care of the deficiency.

2. If further increase is needed for export purposes, there is no reason why this could not have been obtained in the certification class if the needs had been made known, as there was enough foundation stock available for such increases.

3. It is impossible at this late date to conduct an efficient inspection of potato fields and determine whether they will be suitable for seed purposes.

It is hoped that by another year the Food Administration will make known the quantities of seed they will require to take care of unusual demands, so that the entire amount can be certified. If this can not be done, the next best thing would be to make plans for the war approved seed early in the season so that an adequate first inspection of the crop can be made. (Aug. 12).—KARL H. FERNOW.

OHIO

The Cobbler crop has been harvested along the Ohio River. All yields were light. Flea beetle damage has been serious in this section. The harvesting in central and northern Ohio is about a week late, and

as it was just getting under way, heavy rains hindered harvesting operations temporarily.

Potato prices were at ceiling last week. The market is weaker today. There will be no support price on potatoes for Ohio until the first of September when it will start at $2.10 per hundred. If prices at present drop below this, there will be a tendency to hold potatoes until the first of September.

During the last three weeks there has been a tremendous improvement in the late crop in northern Ohio. If the season is late, the yield of late potatoes in this section will probably exceed those of last year. However, weather conditions have been ideal for late blight, and it may break out at any time. Some late blight has been reported but not in serious proportions. (Aug. 16).—Earl B. Tussing.

OREGON

Our larger than normal potato crop is coming along fine at the present time. Our spring was late and wet, and the crop got off to a poor start, but the days for the past two months have been sunnier and not too warm, and many crops are looking as well as they have ever looked. The acreage expansion of course occurred to some extent on poor lands or in the hands of inexperienced growers, and it is likely that our average yield per acre will be lower than usual.

Early potatoes in southeastern Oregon have been selling at less than ceiling prices, but growers who have late varieties expect to get the fall ceilings. Our seed acreage is larger than normal, which is very gratifying.

Ring rot has almost disappeared from most parts of the state and so far we have not found a case of it in any field entered for certification. (Aug. 12).—E. R. Jackman.

Even though our potatoes are a little late, our prospects look good. The seed crop is in good shape and we anticipate a reasonably good yield of high quality potatoes. The commercial crop is not quite so good as the average of the seed crop but it is normal, or only slightly below normal.

The main problem facing our growers is available labor for harvesting the main crop. Our harvesting operations usually begin about the 1st of October. (Aug. 2).—C. A. Henderson.

PENNSYLVANIA

Potatoes are looking very good in Pennsylvania despite the hot, dry weather of the past few weeks. Blight has now been found in eight counties, but is causing damage only in the northwestern part of the state. These counties showed more than six inches of rainfall during July, and for that reason blight can be expected to cause considerable damage here. Our early potato yields have been rather poor. (Aug. 10).—O. D. BURKE.

Potato crop prospects in Pennsylvania are not so bright as they might be. In the southeastern part of the state it has been very dry. Harvesting of the early crop is under way. Yields are running lower than for several years. The set of tubers was generally heavy but tubers are quite small. Prices, at present, are ranging from \$1.30 to \$1.55 per bushel,—depending on the local supply.

In other parts of the state it has been wet and growers report poor prospects with some blight and many weeds.

The crop entered for seed certification is larger this year than in 1942. The first inspection is almost completed, and several fields have already been given a second inspection.

Last year we certified 885 acres in Pennsylvania. Present prospects indicate that more than 1,000 acres may pass the final inspection.

On the 4th of August approximately 600 potato growers and their friends assembled at Camp Potato in Potter County for the Annual Field Day. The extensive breeding and test plots at the Camp were observed under the direction of Dr. E. L. Nixon. Dr. Nixon also gave an inspiring talk to the group.

Miss Carol McHenry, 18, a brunette from Columbia County, was crowned "Potato Blossom Queen" for 1943, by the Secretary of Agriculture, Miles Horst. Miss McHenry was one of seven beauties entered from various potato growing areas of the state. The crowning of the Queen is a part of the annual ceremonies. (Aug. 16).—K. W. LAUER.

SOUTH DAKOTA

The potato crop in South Dakota will be the largest since 1932. Yields in the certified potato section around Watertown will also be larger than that of last year.

This season 4,875 acres of potatoes were entered for certification.

The field inspection work is now completed and only 246 acres were rejected. The early fields are maturing rapidly, and harvesting operations will begin the last week in August.

No late blight has been found in any fields entered for certification. Our recent rains will increase the production to a large extent.

A new packing shed and washer are under construction at Garden City, and a warehouse with a washer installed is being built in Clark County. By the way, Clark County has the largest certified acreage in the state.

The certified seed growers have not sold any stock at this time. but Florida buyers are here at present looking over fields and lining up cars for their early planting. Growers are inclined to ask $4.00 per cwt. f.o.b. shipping points.

The quality of the crop will be very good and it now appears that the size will be very uniform. Three thousand three hundred and ninety-nine acres of Bliss Triumphs have passed for certification, and 961 acres of Irish Cobblers. The balance of the acreage is comprised of Early Ohios, Katahdins, and Red Warbas. (Aug. 11).—JOHN NOONAN.

VERMONT

Continued rainy weather during the first part of August threatens much loss to Vermont's potato acreage. Little late blight had appeared by the 14th of August. Since the growers were unable to keep a normal amount of spray on the plants, however, the moist condition in the fields rendered conditions favorable for blight development.

Only small, very early planted fields have been harvested and these largely for home use. No price has therefore been established. It becomes more and more apparent, however, that the Government will be called upon to purchase a large part of the crop. Industry committees are being set up by state and county war boards to arrange for assembling and grading stock. Growers are warned, however, to make provision for local storage so far as possible. Many potatoes will have to be stored in cellars.

The acreage enrolled for certification is more than double that for several preceding years, totaling somewhat over 800. Our first inspection reports are not yet fully compiled, but rejections probably will not total more than 15 to 20 per cent. (Aug. 16).—H. L. BAILEY.

WASHINGTON

A very much needed rain occurred in Washington during the first week in August. Now the prospects for a good potato crop are almost assured.

Most of our certified seed has been sold to California buyers on the basis of price ceilings. We have had no official announcement concerning the ceilings for certified seed. Our seed potato planting for 1944 will depend very much upon whether or not price ceilings are established sufficiently high to cover the advancing costs involved. If the price ceilings are established too low it will undoubtedly curtail, to a great extent, the planting and production of certified seed. (Aug. 9). —CHAS. D. GAINES.

CANADA

Certified Seed Potatoes. Approximately 34,000 acres have been entered for certification this season, an increase of 4,000 acres, or 13 per cent compared with last year. The entries from the Maritime Provinces total 28,000 acres, an increase of 3,000 acres, or 12 per cent.

The principal varieties entered are: Green Mountain, 13,100 (11,694) acres; Irish Cobbler, 9,146 (8,365) acres; Katahdin, 6,547 (6,229) acres; Sebago, 1,525 (269) acres; Bliss Triumph, 1,435 (1,483) acres; and Netted Gem, 1,103 (828) acres.

The figures in brackets give the acreages entered in 1942. The most remarkable feature is the large increase in the Sebago acreage.

Nearly 3,000 acres have been planted in tuber units this year, which is more than double last year's tuber-unit acreage. (Aug. 10).—W. N. KEENAN.

CANADA

Regulations for the Province of Ontario have recently been passed under The Plant Diseases Act in connection with prevention and control of Bacterial Ring Rot in potatoes. Although the disease has not yet become wide-spread throughout the Province, regulations were considered necessary to safeguard the industry.

If Bacterial Ring Rot is found on any farm, or in any warehouse, storage or processing plant, it will now be necessary for those directly in charge to dispose of all potatoes on such land or premises as the Director in charge may prescribe. It will now be further necessary to

disinfect such premises and all equipment pertaining thereto, including machinery, bags and containers, in such manner and with such disinfectant as the Director may prescribe.

When any potato machinery or other potato equipment, except sprayers and dusters, has been moved from one farm to another, such machinery shall not be used in production, planting, cultivating or harvesting potatoes until the machinery or equipment has been disinfected in such manner as the Director may prescribe.

Efforts are being made to impress upon growers and dealers the seriousness of this comparatively new disease in the Province. It is hoped that spread and development will be curtailed by means of prevention and sanitary methods.

A farm to farm survey in specialized potato producing areas is now being planned to ascertain the exact extent and prevalence of the disease. (Aug. 17).—R. E. Goodin.

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RING ROT INCREASE IN POTATO SEED LOTS HAVING KNOWN QUANTITIES OF INFECTION

G. H. STARR

Wyoming Agricultural Experiment Station, Laramie, Wyo.

1. *Seed Lots Having a "Trace" of Ring-Rot.*

In order to secure more information relative to the justification of a ring-rot tolerance in certified seed potatoes, several one-bushel samples were tested at the Wyoming Agricultural Experiment Station in 1942. These samples were sent at the request of Dr. T. P. Dykstra from the following states: Maine, Nebraska, North Dakota, Minnesota and New York. All samples were selected by the respective donors on the basis that they contained a "trace" of ring-rot. These samples were to be planted and inspected to determine how much ring-rot spread would take place in the subsequent crop, through the ordinary cultural practices. Similar work was planned also for other states. The subsequent report summarizes the work done in Wyoming.

Just previous to planting, each lot of potatoes was inspected and divided into the three subgroups as follows: (1) small tubers, to be planted whole; (2) larger tubers, to be cut for planting; and (3) rotted tubers or those unfit for planting. These were later tested for the presence of ring-rot by the gram-stain method. The number of rotted tubers found, together with the number of those rots that contained ring-rot bacteria was as follows for the various lots: Maine—3 rots, all containing ring-rot bacteria; Minnesota—7 rots, 5 with ring-rot; Nebraska—5 rots, 4 with ring-rot; New York*—22 rots, 6 with ring-rot and North

*This lot of seed was mis-sent to Beltsville, Md., and was in transit longer than the others. This accounts for the larger amount of rot.

Dakota—3 rots, all containing ring-rot bacteria. The small tubers and the seed pieces cut from the larger tubers were counted and planted separately so that the proportion of cut seed and whole seed could be determined. The lots were planted with an assisted-feed planter and without a seed treatment in order to permit a maximum amount of ring-rot spread to take place. However, the planter was disinfected between each lot planted so that there would be no spread of ring-rot between the potatoes from the different states. The potatoes were planted on the 29th of May, and received an application of irrigation water on the following dates: 8th and 28th of July and the 12th and 25th of August. They were inspected in the field for ring-rot symptoms on the 4th, 9th and 27th of August, and on the 8th of September.

Shortly after the last inspection, all plants were staked that showed even a suspicion of ring-rot. Later on stems were collected from each of the staked hills and were used to make stem smears which were gram-stained for subsequent microscopic examination. The percentages of ring-rot were then calculated for each lot of potatoes. Table 1 shows the number of hills in the whole-tuber and the cut-tuber lots, the amount of ring-rot present as shown by plant symptoms and also by the gram-stain method and the percentages of ring-rot resulting from "trace" ring-rot seed lots.

2. *Seed Lots Having 0.10, 0.25, 0.50 and 1.00 Per Cent of Ring-Rot.*

In order to conduct this study further, five lots of healthy seed were used in which known amounts of ring-rot infected tubers were introduced. Each lot consisted of a 100-pound sack of Bliss Triumph potatoes. During the cutting process the following amounts of ring-rot were introduced in the respective samples: 0.10 per cent or 1 tuber; 0.25 per cent or 2 tubers; 0.50 per cent or 3, and 1.00 per cent or 4 tubers. One sack was also used as a check. The ring-rot infected tubers were well spaced in the cutting process in order to permit the maximum amount of infection from the cutting knife which was contaminated by the cutting of the infected tubers. As each tuber was cut into seed pieces, one-half of it was placed into one container whereas the other one-half was put into another. In this manner, all the tubers were equally divided, and one-half of them was treated with corrosive sublimate (1:500) for 20 minutes, while the other one-half was left untreated.

These potatoes were planted soon after cutting and treating by means of an assisted-feed planter. The planter was disinfected with copper sulphate (1 pound to 10 gallons of water) between the planting of each of the ten lots of potatoes.

TABLE I—*The total number of hills, and the amount of ring rot in potatoes from different states as shown by plant symptoms and by the gram-stain method.*

Source	Kind of Seed	Number Hills	Ring-rot Plant Symptoms (No. of Plants)		Ring-rot Gram-stained (No. of Plants)	Ring-rot Gram-stained (Per cent of Plants)	Ring-rot State Sample (Per cent of Plants)
			Definite	Questionable			
1. Maine	Whole tubers	27	0	0	0	0.00	
	Cut seed pieces	380	0	3	3	0.79	0.74
2. Minnesota	Whole tubers	123	1	5	6	4.88	
	Cut seed pieces	354	1	8	5	1.41	2.31
3. Nebraska	Whole tubers	52	0	0	0	0.00	
	Cut seed pieces	467	2	0	7	1.50	1.35
4. New York	Whole tubers	22	0	0	0	0.00	
	Cut seed pieces	298	1	5	2	0.67	0.63
5. North Dakota	Whole tubers	72	0	1	1	1.39	
	Cut seed pieces	386	1	12	6	1.55	1.53

TABLE 2—*The amount of ring rot present in various treated and untreated potato lots having known amounts of infection.*

Amount of Ring-rot Infection (In Per cent)	Number of Infected Tubers Used to Obtain Infection	Seed Treatment Before Planting	Number Hills	Ring-rot Plant Symptoms (No. of Plants)		Ring-rot Gram-stained (No. of Plants)	Ring-rot Gram-stained (Per cent of Plants)
				Definite	Questionable		
0.10	1	None	406	3	5	6	1.48
0.10	1	Mercuric chloride	334	1	8	2	0.60
0.25	2	None	481	13	14	23	4.78
0.25	2	Mercuric chloride	411	1	4	3	0.73
0.50	3	None	538	13	10	32	5.95
0.50	3	Mercuric chloride	491	3	9	6	1.22
1.00	4	None	535	95	..	100	18.69
1.00	4	Mercuric chloride	582	3	6	15	2.58
None (check)	None	None	413	0	0	0	0.00
None (check)	None	Mercuric chloride	397	0	0	0	0.00

The plants were inspected in the field for ring-rot symptoms as in the previous experiment. Similarly also, all plants having ring-rot or even suspicious symptoms were staked previous to harvest. Just before digging the potatoes, stems in each staked hill were collected and used to make stem smears for subsequent gram-stains and microscopic examination. The results may be seen in table 2.

Summary

One-bushel samples of potatoes, each containing a "trace" of ring-rot, were sent from Maine, Minnesota, Nebraska, New York and North Dakota to the Wyoming Agricultural Experiment Station, where they were grown in 1942 to determine the amount of ring-rot increase in the crop.

Each state sample was divided according to tuber size and planted separately either as whole tubers or as cut seed pieces. Ring-rot infection in each lot was determined both by plant symptoms and by the gram-stain method. The per cent of ring-rot by the latter method varied from 0.63 to 2.31 per cent in the five lots from the different states. Thus, the samples with a "trace" of disease produced an average of 1.31 per cent of ring-rot in the subsequent crop.

In addition, larger amounts of ring-rot were introduced in healthy seed, one-half of which was treated and the other one-half left untreated. The percentages of ring-rot introduced in the different lots were as follows: 0.10, 0.25, 0.50 and 1.00.

The resulting ring-rot in the treated lots ranged from 0.60 to 2.58 whereas in similar untreated lots it ranged from 1.48 to 18.69 per cent.

PAST ACCOMPLISHMENTS AND FUTURE OBJECTIVES OF THE POTATO NOMENCLATURE COMMITTEE OF THE POTATO ASSOCIATION OF AMERICA

Wm. Stuart

Takoma Park, Washington, D. C.

For the benefit of those who may not be familiar with the early history of the Potato Association of America, particularly with respect to its organization and its objectives, it seems desirable to the writer to submit the following brief statement.

In the Constitution and By-Laws of the Association, adopted at its First Annual Meeting held at Cornell University, February 10-11, 1914, there was included, among the fourteen objectives listed under Article 2,

one which read as follows: "To provide for the proper description of varieties and the establishment of a bureau of registration and nomenclature for new and worthy introductions."

Under Section 8 of the By-Laws providing for "Committees," ten are designated, one of which was on "Varietal Nomenclature and Testing." This committee submitted its report at the Third Annual Meeting of the Association held at Washington, Nov. 13-14, 1916. The report, entitled "Varietal Types," dealt with the type characters of the Irish Cobbler, Triumph, Early Ohio, Green Mountain and the Rural New Yorker No. 2 groups. These type descriptions were designed to serve as a basis of comparison of varieties having similar plant and tuber characters, with a view to their being classed as synonyms. It may therefore be regarded as the first accomplishment of the "Potato Nomenclature Committee."

The following recommendations were made by the "Committee" at the Fourth Annual Meeting of the Association, also held at Washington, November 9-10, 1917.

"1. That immediate steps be taken toward the development of seed stock from reliably named commercial varieties, particularly of those belonging to the leading groups, such as the Irish Cobbler, Green Mountain and the Rural groups, with the idea that this seed shall serve as foundation stock upon which all varietal studies are to be based. Insofar as possible this stock should be procured from those who have grown it continuously since its introduction."

"2. That we enlist the active cooperation of Experiment Station workers in a careful study of the varieties (or so-called varieties) belonging to a given group. This study to be undertaken for the purpose of determining how many so-called varieties within the group are sufficiently distinct to warrant a varietal name, and to further determine which of the recognized varieties are superior to the older varieties of the group. For example, what varieties in the Rural group are superior to the Rural New Yorker No. 2. And to further determine whether some of the varieties are less subject to disease, or more resistant to heat or drought; in short, to find out whether they possess certain physiological attributes which make them more desirable to grow than other members of the group."

"3. To make such a study possible and to continue it over a period of years, it will be necessary to provide for some reliable source of seed supply which will be available to all cooperators."

"4. That we invite the cooperation of the 'Department of Plant Registration' of the Society of American Florists, and similar committees

of other organizations, particularly of the Vegetable Growers' Association of America, and the American Seed Trade Association for the purpose of establishing some definite plan of registration for the new potato introductions."

"5. That we take such steps as may be necessary to establish trial grounds for the testing of all the new potato varieties as they are introduced, endeavoring insofar as possible to enlist the cooperation of the introducer to the extent of supplying the committee with sufficient seed stock to admit of an adequate trial. All such varieties submitted for trial are to be accurately described, classified, named or renamed, if name has previously been given to a potato variety."

"6. That steps be at once taken by the Committee to formulate a descriptive note-taking sheet which will insure uniform observations by those engaged in variety testing and classification studies." (Such a descriptive sheet was included in the Committee's report.)

The Committee's report submitted at the Eighth Annual Meeting held at Toronto, Canada, December 30-31, 1921, contained, among other things, the results of an attempt to secure a representative list of potato varieties presumably still being grown in the United States and Canada. This list was secured through the cooperation of Experiment Station and College of Agriculture workers. Thirty-nine cooperators assisted in the survey and 531 varietal names were reported. As tabulated by the Committee, 18 were regarded as synonyms of the Irish Cobbler; Triumph, 12; Early Michigan, 11; Early Rose, 19; Early Ohio, 16; Green Mountain, 69; Rural New Yorker No. 2, 59; Russet Rural New Yorker No. 2, 12; and 16 of Up-to-Date. The assignments to the Peerless (Pearl) group and to the Peachblow group are omitted, due to the fact that later data indicated errors in judgment.

As a result of these studies and of knowledge of facilities provided for similar studies in England and Scotland it is recommended that central trial grounds be established at which all of our present commercial varieties may be grown and studied by the Committee.

In a letter written under date of February 6, 1936, by the writer, the following questions were submitted to the members of the Committee, Messrs. C. F. Clark, C. H. Metzger, J. C. Miller and L. C. Young.

"Ques. 1. Are there any nomenclature problems in your section? If so, what are they?

"Ques. 2. Do you think it would be advisable for each member of the committee to study all varieties of questionable nomenclature with a view to their proper identity?

"Ques. 3. In your opinion would it be advisable to request all

originators of new varieties to submit a sample to the Committee for study prior to their introduction?"

The first two members replied affirmatively to No. 1; the third replied negatively. No answer was received from the fourth member to any of the questions. All three replied in the affirmative to questions 2 and 3. Points raised in connection with No. 1 query were with respect to the certification of seed stock of varieties identical with Green Mountain, such as Delaware and Gold Coin; or in the case of three types of the Peachblow. One white with a pink eye; the second with a pink skin and red eye; and the third with a dark red skin; or five types of the Triumph based on height of plant, tuber color, tuber shape, time of maturity and number of blossoms. To these may be included questions raised by a non-member of the committee in regard to seed certification. For example, should Red McClure be certified as a Peachblow; or Idaho Rural as Charles Downing; Late Cobbler, and Nittany Cobbler as Irish Cobbler; or Dooley, Heavyweight, No. 9 and other similar varieties as Rural New Yorker No. 2. This method in the case of the Irish Cobbler, Green Mountain, Rural New Yorker No. 2, and Charles Downing was approved. With respect to the five types of Triumph it was suggested that they either be distinguished as Triumph No. 1, 2, 3, 4 or 5, or by season of maturity for example very early, early, medium, medium-late and late. In any case the name Triumph should be retained. In the case of Red McClure, while it is plainly a member of the Peachblow group it was considered sufficiently distinct to justify retention of its name.

In the writer's judgment the chief accomplishment of the Potato Nomenclature Committee has been that of the elimination of a large number of so-called varieties by proving them to be synonyms of well-known commercial varieties, the renaming of which proved financially profitable to unscrupulous seedsmen. In several instances careful comparison of varieties of unknown origin with older varieties not commonly grown has made its identity possible. Examples of this sort are found in Brown Beauty which was identified as the Prolific; Pearl which was found to be the Peerless; Jersey Redskin which proved to be Dakota Red; Idaho Rural a re-named Charles Downing, etc.

Some attention has also been given to minor mutations such as skin type and tuber color. In skin type the commonest form of mutation is that of russeting. The best known examples are the Russet Rural New Yorker No. 2 or Russet Rural and the Russet Burbank (Netted Gem, etc.); in tuber, or skin color, the White Early Ohio, and White Triumph are the best examples. In England two examples are cited by

the Potato Synonym Committee in which distinct names were given to russet skin mutants of Great Scot, and of Up-to-Date. These names have been dropped and the prefix Russet used to designate the mutated type of these two varieties. Likewise, in a case of skin mottling of Edgecote Purple the Committee ruled that it should not be recognized by a distinctive name other than "Mottled Edgecote Purple." Application of this ruling to the identical American varieties Noroton Beauty and Quick Lunch which are recognized as a skin color mutation of the Triumph, this mutant should be designated as a "Mottled Triumph."

Many other examples might be cited but enough has been said to indicate what is recognized as the proper nomenclature procedure.

Future Objectives in Potato Nomenclature Studies. In offering the following suggestions regarding the future objectives of potato nomenclature studies by the Potato Association of America the writer wishes it understood that such suggestions are not those of the Potato Nomenclature Committee but simply the expression of his own viewpoint as to procedure believed necessary to attain the desired objectives.

Varietal Selections and Their Designation. One of the most pressing problems of nomenclature is that of the proper procedure to follow in determining whether a selection from a named commercial variety of potato should be given a distinctive name of its own. How shall we determine whether a selection is sufficiently different in morphological or physiological characteristics to be worthy of a separate name? In this connection we would again call your attention to the recommendations cited from the report of the Potato Nomenclature Committee of the Potato Association which suggested that the active cooperation of Experiment Station workers should be enlisted in a careful study of varieties, or so-called varieties belonging to a given group to determine how many possessed characters sufficiently distinct to merit a varietal name. The same method of study should apply equally well in the case of varietal selections.

Generally speaking varietal selections from leading commercial varieties are based on such factors as vigor of plant, productiveness or certain minor differences in plant or tuber characters which as a rule are not easily recognized. Too often superiority of performance as regards yields are due to better quality seed than that of the parent plant with which the comparison was made.

In all comparative studies of this nature it is essential to use seed of both the parent, and the selection, therefrom, which has been grown under the same environmental conditions and also of storage, in order to eliminate the influence of these factors on the quality of the seed.

Such a study should prove very helpful in discouraging the practice of giving distinctive names to selections which do not differ in any material sense from the parent plant.

Abbreviation of Name. Should any attempt be made to abbreviate a name, and if so what part of the name should be dropped? This question is being raised with a view to eliciting an expression of opinion on the following treatment of a binomial name in which the last name has been dropped. The variety in question is that of President Krüger. The Potato Synonym Committee of the National Institute of Agricultural Botany (England), for some unexplained reason, has dropped, what to the writer seems to be, the significant part of the name: *viz.,* Krüger. Recognition of such change of name is indicated in publications by Dr. H. V. Rathlef (3), Dr. Karl Snell (4) and Dr. Klapp (2), in the following manner: President Krüger—President (England). It is not believed that such change is desirable.

We have been led to cite this treatment of a name on account of the fact that President Krüger is being grown in certain regions in the United States and Canada under the name of President. Furthermore a variety locally known in Aroostook County, Maine, as Foster's Rust Proof has been found to be identical with President Krüger.

According to information published by Bonde (1), F. W. Foster of Fort Fairfield, Maine, claims this variety was produced by James K. Paisley of Albert, New Brunswick, Canada, who claims to have grown it from seed of unknown parentage, other than a suggestion that the seed was possibly the result of a composite cross (natural) involving the varieties Irish Cobbler, Green Mountain, Carman and Beauty of Hebron. (The unlikelihood of such a parentage is self evident). Mr. Paisley is said to have named his seedling Forty Fold. It is of interest to note that both names—Rust Proof and Forty Fold were previously given to seedling potatoes. The former to a seedling produced by N. P. Hulett of Pawlet, Vermont, about 1900, and the latter to a seedling produced by Paterson toward the middle of the nineteenth century. Further reference to these two instances will be made later on.

Re-use of Varietal Names. It is believed that the use of names previously given to potato varieties not now known to be in existence should be avoided. In this connection the Potato Association of America might render, through its Nomenclature Committee, a distinct service to all originators or introducers of new varieties by suggesting available names or in calling attention to the fact that a proposed name has previously been used.

Monomial or Binomial Names. It is gratifying to observe that

all recently introduced seedlings bear a monomial name and, what is still more important they have been accompanied by a careful description of plant and tuber characters. This should prove of inestimable value to future students of potato nomenclature.

Use of a Prefix or a Suffix. Mention was made in an earlier portion of this article in regard to the addition of a "prefix" or "suffix" to designate certain mutants of a variety in which the parental name is retained. Examples of such use were also cited. It is believed that certain additional uses of a prefix or suffix might be permissible in the case of varietal selections in which the selectionist wishes to retain his identity. For example Toan's Rural New Yorker No. 2 is used instead of Toanco, which in no sense preserves the identity of the parent variety. Used as a suffix it would read Rural New Yorker No. 2, Toan's selection. By such recognition the selectionist would be more certain of profiting from his work. On the other hand, such privilege would place an added responsibility on the Nomenclature Committee in making certain that the selection did represent a superior strain of seed.

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FACTORS INFLUENCING THE GERMINATION OF SEEDS OF THE POTATO

A. E. Clarke[1] and F. J. Stevenson[2]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, Beltsville, Md.

Newly harvested seed of the potato (*Solanum tuberosum* L.) frequently germinates slowly and irregularly. This delayed germination often interferes with potato breeding operations, consequently the present study was undertaken in an effort to discover a treatment that would overcome, or at least, minimize this difficulty.

[1]Associate Cytologist.

[2]Senior Geneticist.

[3]Dr. E. H. Toole of the Bureau of Plant Industry, Soils and Agricultural Engineering, kindly provided the controlled temperature chambers and gave valuable help and suggestions.

Review of Literature

A number of factors have been found to influence the germination of potato seeds. Both Stcherbacheva (3) and Stevenson and Milstead (4) found that new seeds do not germinate as well as old, and Odland (2) showed that genetically different samples of newly harvested seed may exhibit marked differences in the degree of delayed germination. Stier and Cordner (7) reported that the percentage of germination was uniformly high from 15° to 25° C. and that the rate of germination was most rapid at 20°. Stier (5) concluded that the delayed germination is caused by some tissue or agency exterior to the embryo, and in a later paper (6) suggested that it might result from the inhibition of oxygen absorption by the thick outer walls of the nucellar layer.

Materials and Methods

In the following experiments self-pollinated seed of S. 245-25 was used. The seed referred to as "old seed" had been stored for 2 years in a refrigerator at approximately 35° F., whereas the "new seed" was planted about 2 weeks after it had been removed from the seed balls.

In an experiment designed to determine the effect of depth of planting on seed germination, a study was made of four depths of planting and three types of covering. Old seed was planted on the 2d day of July, 1942, in the greenhouse at Beltsville, Maryland. This seed was planted in sterilized soil in 4-inch pots, and then covered with soil, with a mixture of 50 per cent soil and 50 per cent sand, or with sand only, to a uniform depth of 1, ½, ¼, or ⅛ inch, thus giving twelve treatments in all. The greenhouse temperature was not controlled, but all lots were subjected to the same temperature conditions.

The germination of old and new seed was compared by sowing both sorts on moist paper toweling in petri dishes, and germinating them in constant temperature chambers at 20°, 25°, and 30° C., respectively.

A further comparison was made of new seed that had been separated from the seed balls in three ways: (1) Seeds removed from the seed balls and washed in several changes of water just long enough to remove the debris from the seed balls and then promptly dried on a layer of cheesecloth placed on a drying rack; (2) seeds and seed-ball residue soaked in water over night before washing and drying; (3) seeds and seed-ball residue allowed to ferment in water for several days before washing and drying. Eight series of germination temperatures were also tested:

(1) A constant temperature of 12° C.
(2) A constant temperature of 20° C.

(3) A constant temperature of 25° C.
(4) An alternating temperature of 12° C. for 17 hours, and 25° for 7 hours each day.
(5) An alternating temperature of 20° C. for 17 hours, and 30° for 7 hours each day.
(6) A temperature of 3° to 5° C. for 7 days, followed by an alternating temperature of 20° for 17 hours, and 30° for 7 hours each day.
(7) A temperature of 3° to 5° C. for 14 days followed by an alternating temperature of 20° for 17 hours, and 30° for 7 hours each day.
(8) A temperature of 3° to 5° C. for 21 days, followed by an alternating temperature of 20° for 17 hours, and 30° for 7 hours each day.

The seeds in each series were planted in 3-inch pots in soil and also on moist paper toweling in petri dishes.

The effect of potassium nitrate in breaking the rest period was studied by soaking new seed at room temperature for 24 hours in aqueous solutions of 0.2, 1.0, and 2.0 per cent. Lots were germinated in both soil and petri dishes at temperatures of 20° C. for 17 hours and 30° for 7 hours each day.

The effect of sulphuric acid on germination was also tested. Samples of new seed were soaked in a 75-per cent solution of sulphuric acid for three different periods: 15, 30, and 45 minutes. After soaking, the samples were washed thoroughly in running water and then immediately tested for germination. The results were extremely unsatisfactory. Molds developed on the petri dishes, and these may have prevented germination; but in soil in which no mold development was apparent the germination of the seeds treated with sulphuric acid was also negligible. Consequently, no further discussion of the sulphuric acid tests is presented in this paper.

In all experiments 100 seeds were planted in each individual 3-inch pot or petri dish. Each treatment was replicated three times, so that it consisted of three samples of 100 seeds each.

Germination counts were made daily. Seeds germinated in petri dishes were counted as soon as the radical was about 5 mm. to 1 cm. long, but those germinated in 3-inch pots were not counted until the seedlings emerged through the soil. The difference in method of counting explains, at least in part, the seemingly slower germination of the seeds grown in soil.

The differences necessary for significance were calculated from the

standard error secured from an analysis of variance. The coefficients of velocity of germination were calculated according to the method devised by Kotowski (1), using the equation:

$$\text{Coefficient of Velocity} = \frac{100(A_1 + A_2 \ldots\ldots\ldots\ldots Ax)}{A_1T_1 + A_2T_2 \ldots\ldots AxTx}$$

A = the number of seedlings sprouted.
T = the number of days after planting, corresponding to A.

Experimental Results

The effect of depth of planting and type of covering on the percentage of germination of the 2-year-old potato seeds are shown in table 1. The amount of germination was rather low for all treatments,

Table 1—*Effect of depth of planting and type of covering on the percentage of germination of 2-year-old potato seeds.*

Type of Cover	Percentage of Germination at Different Planting Depths				Mean[1]
	1 Inch	½ Inch	¼ Inch	⅛ Inch	
	Per cent	Per cent	Per cent	Per cent	
Soil	10	20	35	45	28
50 per cent soil + 50 per cent sand	12	21	22	57	28
Sand	6	19	40	54	30
Mean[2]	9	20	32	52	

[1]Differences not significant.
[2]Difference required for significance at 5-per cent level, 7.2; at 1-per cent level, 9.8.

since the temperature in the greenhouse was not controlled and ran too high for optimum germination. Shallow planting gave more seedlings than deep planting, the percentage varying from 51.9 at ⅛-inch depth to 9.2 at 1-inch depth. The differences between covering the seeds with soil, 50 per cent soil and 50 per cent sand, and sand were too small to be significant.

Depth of planting also influenced the velocity of germination of the old potato seeds, the most rapid rate of germination being obtained with the shallow planting as shown in table 2. The type of cover produced no

TABLE 2—*Effect of depth of planting and type of covering on the velocity of germination of 2-year-old potato seeds*

Type of Cover	Coefficient of Velocity of Germination at Different Planting Depths				Mean[1]
	1 Inch	½ Inch	¼ Inch	⅛ Inch	
Soil	7.8	8.8	11.4	11.2	9.8
50 per cent soil + 50 per cent sand	8.9	10.1	9.7	12.0	10.2
Sand	7.8	10.4	11.8	11.7	10.4
Mean[2]	8.2	9.8	11.0	11.6	

[1]Differences are not significant.
[2]Difference required for significance at 5-per cent level, 0.9; at 1-per cent level, 1.3.

significant differences in velocity of germination.

Two-year-old seed gave a higher percentage of germination than newly harvested seed, the difference being highly significant as you will note in table 3. Both kinds of seed were germinated at temperatures

TABLE 3—*Effect of temperature and age of seed on the percentage of germination of potato seeds*

Age of Seed	Percentage Germination at Temperatures of[1]			Mean[2]
	20° C.	25° C.	20° - 30° C. (Alternating)	
	Per cent	Per cent	Per cent	
New	68	21	72	54
Old	82	63	69	71
Mean[3]	75	42	71	

[1]Seed held at 30° for 3 weeks failed to germinate; it was then held at an alternating temperature of 20° C. for 17 hours and 30° for 7 hours each day.
[2]Difference required for significance at 5-per cent level, 11.3; at 1-per cent level, 16.1.
[3]Difference required for significance at 5-per cent level, 13.9; at 1-per cent level, 19.8.

of 20°, 25°, and 30° C. Neither kind showed any signs of germinating when kept at a constant temperature of 30°, so at the end of 3 weeks an alternating temperature of 20° at night and 30° during the day, was

TABIE 4—*Effect of temperature and method of seed cleaning on the percentage of germination of new seeds of potato.*

Germination Temperature	Germinated in Soil				Germinated in Petri Dishes			
	Fermented Several Days	Soaked Overnight	Washed an Dried Immediately	Mean[1]	Fermented Several Days	Soaked Overnight	Washed an Dried Immediately	Mean[2]
Degrees C.	Per cent	Per cent	Per cent		Per cent	Per cent	Per cent	
12°	30	21	21	24	76	76	49	67
20°	14	24	31	23	62	70	43	58
25°	0	0	0	0	22	15	8	15
12° night, 20° day	60	64	41	55	58	75	37	57
20° night, 30° day	18	23	20	20	64	66	50	60
20°-30° after 7 days at 3°-5°	24	14	12	17	55	62	49	55
20°-30° after 14 days at 3°-5°	6	4	9	6	52	58	37	49
20°-30° after 21 days at 3°-5°	2	0	0	1	47	48	32	42
Mean[3]	19	19	17		[4]55	59	38	

[1]Difference required for significance at 5-per cent level, 7.4; at 1-per cent level, 9.9.
[2]Difference required for significance at 5-per cent level, 7.8; at 1-per cent level, 10.4.
[3]Difference not significant.
[4]Difference required for significance at 5-per cent level, 4.8; at 1-per cent level, 6.3.

substituted. The difference produced by this alternating temperature and the constant temperature of 20° was not significant, but both gave a highly significant increase compared with lots at a temperature of 25°. The interaction between the age of seed and the maintained temperature also proved significant. At 25° the germination percentage of the new seed was more markedly reduced than the old seed. Apparently the new seed is influenced to a greater extent by unfavorable temperature conditions.

The velocity of germination was also influenced by the age of the seed and by temperature. At 20° C. the coefficient of velocity of germination of the old seed was 15.4, whereas that of the new was only 9.5, this difference being sufficiently great to exceed the 1-per cent level of significance. The old seed had a velocity of germination of 9.9 at 25°. as compared with 15.4 at 20° C. This difference is also significant.

New seed germinated much more poorly when grown in soil than when grown in petri dishes at all temperatures tested, except at an alternating temperature of 12° to 20° C. as shown in table 4. In the latter case there was practically no difference in the percentage of germination. In both soil and petri dishes highly significant differences in percentage of germination resulted from differences in temperature. The lowest germination was obtained with the lots kept at a constant temperature of 25°. Chilling in the refrigerator at 3° to 5°, before subjecting the seeds to an alternating temperature of 20° to 30°, decreased the percentage of germination. This decrease was too small to be considered significant after chilling for 7 days, but was highly significant after the longer treatments of 14 and 21 days.

A comparison of three methods of cleaning the new seed is also given in table 4. Seed washed and dried immediately gave the lowest percentage of germination. This difference was too small to be significant when the seeds were germinated in soil, but was highly significant for the seeds germinated in petri dishes.

Not only the percentage but the velocity of germination was lower for seeds germinated in soil than for those in petri dishes (table 5). The differences in velocity of germination were highly significant for temperature and for method of cleaning. There was a marked reduction in the velocity of germination with a constant temperature of 25° C., an alternating temperature of 20° to 30° being more satisfactory. Lower temperatures were still more satisfactory. The rate of germination was also slowed up by pre-chilling.

The seed from seed balls which were allowed to ferment before

TABLE 5—*Effect of temperature and method of seed cleaning on the velocity of germination of new seeds of potato.*

Germination Temperature	Germinated in Soil				Germinated in Petri Dishes			
	Fermented Several Days	Soaked Overnight	Washed and Dried Immediately	Mean[1]	Fermented Several Days	Soaked Overnight	Washed an Dried Immediately	Mean[2]
Degrees C.								
12°	4.8	4.6	4.6	4.7	8.7	8.2	8.2	8.4
20°	5.7	4.7	5.6	5.3	10.1	7.9	7.2	8.4
25°	0.0	0.0	0.0	0.0	4.4	3.5	3.6	3.8
12° night, 20° day	6.0	5.3	6.2	5.8	9.5	8.1	7.8	8.5
20° night, 30° day	4.4	4.4	4.7	4.5	8.1	6.5	6.9	7.2
20°-30° after 7 days at 3°-5°	4.5	4.0	4.7	4.4	5.9	5.1	5.3	5.4
20°-30° after 14 days at 3°-5°	3.9	3.7	3.5	3.7	4.4	4.0	4.1	4.2
20°-30° after 21 days at 3°-5°	3.3	1.0	0.0	1.4	3.8	3.6	3.4	3.6
Mean[3]	4.1	3.5	3.7		[4]6.9	5.9	5.8	

[1]Difference required for significance at 5-per cent level, 0.6; at 1-per cent level, 0.8.
[2]Difference required for significance at 5-per cent level, 0.5; at 1-per cent level, 0.6.
[3]Difference required for significance at 5-per cent level, 0.4; at 1-per cent level, 0.5.
[4]Difference required for significance at 5-per cent level, 0.3; at 1-per cent level, 0.4.

TABLE 6—*Effect of potassium nitrate and method of cleaning on the percentage of germination of new seeds of potato, germinated at an alternating temperature of 20° C. for 17 hours and 30° for 7 hours each day*

Strength of Solution	Germinated in Soil				Germinated in Petri Dishes			
	Fermented Several Days	Soaked Overnight	Washed and Dried Immediately	Mean[1]	Fermented Several Days	Soaked Overnight	Washed and Dried Immediately	Mean[1]
	Per cent	Per cent	Per cent		Per cent	Per cent	Per cent	
Distilled water	20	26	30	25	58	76	57	64
0.2% KNO_3	30	35	33	33	80	77	68	75
1.0% "	40	26	41	36	68	76	78	74
2.0% "	38	20	35	31	67	80	76	74
Mean[2]	32	27	35		[1]68	77	70	

[1]Differences not significant.

TABLE 7—*Effect of potassium nitrate and method of cleaning on the velocity of germination of new seeds of potato, germinated at an alternating temperature of 20° C. for 17 hours and 30° for 7 hours each day*

Strength of Solution	Germinated in Soil				Germinated in Petri Dishes			
	Fermented Several Days	Soaked Overnight	Washed and Dried Immediately	Mean[1]	Fermented Several Days	Soaked Overnight	Washed and Dried Immediately	Mean[1]
Distilled water	5.0	4.1	4.9	4.7	8.0	8.7	8.3	8.3
0.2% KNO_3	5.0	4.5	4.3	4.6	9.6	7.9	8.6	8.7
1.0% KNO_3	5.4	5.4	5.2	5.3	9.8	8.8	8.5	9.0
2.0% KNO_3	5.1	4.9	4.3	4.8	9.5	8.1	7.9	8.5
Mean[2]	5.1	4.7	4.7		[3]9.2	8.4	8.3	

[1]Differences not significant.
[2]Differences not significant.
[3]Difference required for significance at 5-per cent level, 0.6; at 1 per cent level, 0.8.

washing showed a higher velocity of germination in both soil and petri dishes than seed from the other two treatments.

Aqueous solutions of potassium nitrate were not effective in producing significant increases in percentage (table 6) or velocity of germination as shown in table 7, in either soil or petri dishes at a temperature of 20° to 30° C. No significant differences in percentage of germination were obtained between the three methods of seed cleaning when potassium nitrate treatment was used. These differences are recorded in table 6. For rate of germination, however, the difference between means for method of seed cleaning, although not significant for seeds germinated in soil, was highly significant for those germinated in petri dishes (table 7). In the latter case the velocity of germination was greater for seeds from seed balls which had been allowed to ferment than for the other two treatments.

Discussion

High temperatures, 25° C. or above had an unfavorable effect on both the percentage and rate of germination of potato seeds. This effect was more pronounced with new than with the old seed. It is also noteworthy that germination was poorer at a constant temperature of 25° C. than at an alternating temperature of 20° for 17 hours and 30° for 7 hours each day. The high temperatures which prevail in the greenhouse at Beltsville, Maryland, during the summer months are probably chiefly responsible for the irregular germination of many lots of potato seeds planted during the latter part of August.

The method of separating the seed from the seed balls did not appear to have had much effect on the total percentage of germination, but it did affect the rate of germination. The removal of the gelatinous layer that covers the seed by allowing the crushed seed balls to ferment at the time of cleaning gave a higher velocity of germination.

Summary

1. The percentage and velocity of germination of potato seeds was more satisfactory when planted ⅛-inch deep than when planted at a greater depth.

2. No significant differences were obtained between covering the seeds with soil, or with 50 per cent soil and 50 per cent sand, or with sand.

3. High temperatures reduced the percentage and velocity of germination.

4. Alternating the temperature between 20° and 30° C. was more satisfactory than a constant temperature of 25°.

5. A higher velocity of germination was obtained when the seeds and seed-ball debris were allowed to ferment before washing and drying.

6. Soaking the seed in an aqueous solution of potassium nitrate did not affect the percentage or the rate of germination.

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SECTIONAL NOTES

CALIFORNIA

The Stockton potato crop is moving in regular order. So far the demand for the No. 1 grade has been very good on account of the heavy purchasing on part of the Government agencies. However, there has been considerable difficulty in moving the lower grades.

A support program is promised, but so far it has not gone into effect.

Perhaps the solution to this question of surplus on low-grades which appears to be quite pressing not only in this particular district but also in many others, might be found in a general promulgation whereby during this present emergency no potatoes would be packed if they didn't grade *over* 85 per cent U. S. No. 1.

This would absorb a large amount of the lower grades without materially lessening the value and use of the higher grades.

In San Francisco last week, they declared a city-wide "Potato Week" sponsored by the Chamber of Commerce, in which through the cooperation of all groups, growers, wholesalers, jobbers, retailers, chain stores, etc., potatoes were made available to the general public at a very low price; the price figured generally $2.25 per 100-pound sack at the retail store.

This plan will be followed in a number of other coast towns and should be used more generally.

We have too many periods in the perishable business when due to various causes, prices to the growers become greatly depressed—without however, the public ever finding it out! If during such periods, by concerted effort, the low prices could be readily handed down to the consuming public, both the producer and the consumer would greatly benefit. (Sept. 1)—E. MARX.

CONNECTICUT

The precipitation for June, July and August was about two-thirds of the long time average for those months. To date, there has been very little rain during September. It has been estimated that the unfavorable weather has reduced the potato crop in Connecticut more than the increase expected from the 33 per cent additional acreage. (Sept. 10)—B. A. BROWN.

IDAHO

No decided changes have come into the picture in the general potato situation in Idaho since last month. Growers are wondering what effect the extremely cool weather will have on yields and quality, and night temperatures close to freezing lead some folks to forecast early frosts. The weather seems more settled, however, now than a few days ago, and we may get the two to three weeks growing weather which we need for high yields. Some growers in the Upper Snake River Valley have wondered what the continued or late blooming of potatoes may mean.

The early deal is well cleaned up and our early Russets are moving pretty well as far east as Twin Falls with the eastern Idaho district expecting to open up next week. In general, our dealers are expecting prices to remain at support price rather than at nearer the ceilings. There has been no reaction, as yet, from the announcement of non-recourse loans by the War Food Administration. Growers, in general, seem to feel that the Government will keep potatoes at the support prices.

Frosts have occurred in two of the important seed sections, one of which was partially frozen about the middle of July. Yields in these two areas will be fairly light, although early frosts are not uncommon in these districts.

Several different opinions have been expressed as to the amount of

storage available. We have undoubtedly a large increase in storage in commercial trackside, farm cellar and storages built to accommodate dehydration. Whether this is sufficient in all sections still remains in doubt. Some areas will undoubtedly be short, and temporary types of storage may have to be employed.

Federal-State Inspection Service reports show that during the months of July and August there were 2,201 cars of potatoes shipped from Idaho, and they estimate that up to the 10th of September an additional 500 cars will have been moved. This probably represents about one-half of the potatoes in the early Caldwell-Nampa district and the remainder of the later planted Russets. Reports show that dehydrators in western Idaho are experiencing labor difficulties and are probably not handling potatoes to their full capacity. (Sept. 9).—EUGENE W. WHITMAN.

INDIANA

The potato situation in Indiana is not improving. Some few growers, because of other activities and farm work have felt that the potatoes did not need another spray. Therefore, a small amount of blight is showing up here and there, and the leafhoppers and the flea beetles are considerably worse than they have been in past months. Since we have had timely rains, our potatoes have grown well. Quite a few people are harvesting their potatoes and the quality is exceptionally good, but the smaller patches (of an acre or so) that have contributed a lot of potatoes to the general market situation are only about one-half of that which was expected. Various comments have been made by different growers in regard to the potato situation and practically all of them cannot be put in print. Many of our growers are sitting tight, waiting to see what the government is going to do, and the public is in a good mood to buy potatoes at this time if they can get them. Many of our growers are going to save the No. 2 seed from their better plantings for planting next year's crop as we do not certify any seed in Indiana. However, there will naturally be a demand for state-certified seed, but the buying public is not going to endure this coming year what they encountered this past spring. (Sept. 6).—W. B. WARD.

LONG ISLAND

The early potato crop on Long Island, including Cobblers and other early varieties, has already been marketed. The potato growers are now digging their Green Mountains. This crop is much lighter than that of 1942 for several causes. In many fields the set is light, and

the reason for this we cannot explain. Does any one know what is the reasons for light or heavy sets?

Other reasons for a lighter crop of Green Mountains are dry weather, aphids, leafhoppers, and flea beetles. There was no loss from late blight this season.

Because of the uncertainty of future price policies of the O. P. A., farmers will not store so heavily as they normally would.

It is very dry, which makes it impossible for us to get our cover crops started at our normal season. (Sept. 11).—H. R. TALMAGE.

MAINE

The biggest crop on record both for Maine and the country was forecast on the 10th of September. The calm and unconcerned way with which our growers met this announcement furnished quite an insight into basic economics. In other years, quite recently too, a crop of one hundred million bushels less would be greeted with more concern than this present one. It causes one to inquire what other factors are operating besides the good law of "supply and demand" which is referred to so glibly at times.

There is much reason for confidence even in the face of this estimate. With requirements of the armed forces, lend-lease, starch and civilian needs the total volume necessary is tremendous. We can all be thankful that the farmers of this nation turned to and produced this crop, and we can see too what a tremendous factor "incentive payments" played in encouraging farmers to plant a larger acreage than they could see their way clear to care for properly. The price support, too, has played a big part in assuring growers somewhere near the cost of production. These factors are helping tremendously now to strengthen what otherwise might be a weak situation.

The words "incentive payments" or "subsidies" might be something to conjure with by the politicians and politically-minded farm leaders who seek to upset any program that they didn't think of first, but the rank and file, the honest-to-goodness farmers are not disturbed by vague slogans or catch words. Subsidies and incentive payments have been made under various guises for generations to achieve particular purposes in the national interest. Any citizen shares in some form of subsidy every day of his life. The benefits from this encouragement by the government are eloquently shown in the potato crop this year.

The oft quoted expression "never a dull moment", certainly applies to the potato business in Maine. A year ago we were troubled greatly

with drought, aphids, fleas, beetles and blight. Today we are troubled with too much moisture, green tops, a very much delayed season, and shortage of labor. Very little harvesting has been done so there isn't much to report on that at present. We are fearful of some hollow-heart and some blight rot but are hopeful that there will not be an excessive amount to show up at harvest time. Next week will see the start of harvesting operations on many farms. Our yields are excellent and there is every prospect that this condition will continue to be found.

Many growers are stort of storage but there has never been a year when so much storage construction has been in evidence as this season, even with our shortages of material and labor. It may possibly be found that there will be sufficient storage to take care of the great bulk of this crop. Some growers though, and too often small growers, are without any storage at all, which is working a real hardship for them.

There has been a great deal of trading in "futures" this year, more than ever before. This reflects, undoubtedly, a strong under-current of confidence in the market this winter. This future trading applies more to table stock than it does to seed.

Our second inspection is completed and it would now appear that the acreage will finally arrive at approximately the same figure as last year's total. Yields per acre will be heavier but more large-size stock will be discarded. All inspectors are rejecting any fields showing bacterial ring-rot, and making every effort to protect the buyers from this disease.

The announcement of price ceilings is being awaited with much interest for the fall and winter months on both seed and table stock. The uncertainty, in the meantime, is causing some confusion, but we are all more concerned with getting the crop out and under cover now.

Although labor is very short, the Maine Extension Service is doing a great work in bringing in labor from other states and assisting in every conceivable way to secure harvest help. We are confident that the crop will be gotten out of the ground in time. (Sept. 13).—FRANK W. HUSSEY.

MICHIGAN

Generally speaking, our crops are suffering from a lack of rain. They now seem to be beyond much help. Yields will be lower than had been expected. It appears now as if the government estimate is higher than the yield that will be harvested.

Harvesting is starting and will be well under way by the 20th of September. The quality is generally good and the size of the tubers is ranging smaller than usual. (Sept. 8).—H. A. REILEY.

NEBRASKA

The potato situation in Nebraska has gone from bad to worse in the last two or three weeks. In the dry land areas the good growth of early August resulted in large plants, which needed ample moisture to carry into the fall. Following these good conditions, the weather turned hot, and continued to be dry,—except for local rains,—and the plants fired badly during this period.

About the first of September, cool conditions prevailed, and rain fell in moderate quantities. Following this period, there were a number of days of cool weather, and during the week of the 5th, there were mild frosts in many areas. Then on the morning of the 8th we experienced heavy frost, which caught most of the fields, except the irrigated fields in the North Platte Valley, which escaped to a great extent. The result of this series of frosts, culminating in a heavy one, will be a 50 per cent reduction in yield below that expected on the dry land, and 30 to 50 per cent on the irrigated fields, that were affected. Certainly not over one-fourth of the territory has escaped damage, and even there, normal yields are not to be expected, because of the erratic wind-up of the season.

Seed potato certification work was cramped, as is the case in many other states, because of the lack of inspectors. The work was accomplished, however, and approximately 8500 acres were inspected in the field. This is about 5 per cent increase in acreage compared with a year ago. The statements made concerning the condition of the crop, of course, apply to the certified grower, as well as the table stock producer. We expect a rather serious cut in the certified production, despite the increase in acreage.

The support price in effect on table stock will be $1.85 per cwt. for the period until the 1st of December; $2.00 per cwt. for December and January; and $2.15 thereafter. Ceiling prices have not been announced for this area.

A fairly substantial acreage was entered for War Approval, and field inspection was made thereon. At this writing, considerable confusion seems to exist as to the status of the War Approved potatoes. A number of changes have been made since it was originally announced.

Harvest will undoubtedly commence within two weeks, though the bulk of the harvest does not take place until after the 1st of October. (Sept. 11).—MARX KOEHNKE.

NEW JERSEY

Approximately 85 per cent of New Jersey's main potato crop is now harvested. Our yields range from 50 to 180 cwt. per acre, because of the effect of local showers in some areas and the extremely inadequate rainfall in other sections of the state. Some growers will not be able to make expenses, whereas others who have had satisfactory yields have been very successful.

Although prices have strengthened slightly for the past two weeks, the bulk of our crop had already been moved at support prices. The support price, however, was paid to dealers for loaded cars f. o. b. shipping point, and farmers received $2.05 per cwt. for graded stock on the farm rather than the $2.20 support price that many expected. After deducting the costs of sacks, picking and grading from this price, many growers will realize a net price of approximately $1.60 per cwt. With an average yield of nearly 100 sacks per acre, it is readily seen that the crop, as a whole, has not been very profitable in view of the high production costs.

Eight hundred and thirty-three acres of late crop seed potatoes have been entered for certification, which is 175 acres more than was entered last year. Nearly one-half of this acreage, or 404 acres, are of the Katahdin variety, whereas 160.7 acres are devoted to Chippewas; 120 to Sebago, and only 49 acres to Cobblers. The remainder of the acreage is divided among five other varieties. (Sept. 15).—J. C. CAMPBELL.

OREGON

Certified seed potato acreage greatly increased this year. The Klamath County acreage in 1942 was 700, whereas in 1943 it is 1400. The majority of the acreages entered will meet certification requirements. The quality is higher than usual.

A heavy frost occurred on the night of the 29th of August, the temperatures dropping to 27 and 28 degrees throughout the Klamath project. The potato tops were generally frozen throughout the project and our estimated loss in yield is 15 per cent. Our potatoes are now being harvested, and our yields, to date, are fair. (Sept. 9).—C. A. HENDERSON.

PENNSYLVANIA

Southeastern Pennsylvania is still suffering from lack of moisture. The yield of the late potato crop in this area will be smaller than was anticipated. Our yields are running very low.

In the northern-tier counties, and especially in the Potter County area, growers anticipate a good crop. The tuber set was light in this area but a good crop is in prospect, because the tubers may run somewhat larger than normal.

In the western part of the state rainfall has been localized. In some areas it has been wet while nearby sections lacked sufficient moisture to produce a good crop. The crop in this area will be somewhat spotty.

There were approximately 2000 acres of potatoes entered for seed certification this year compared with slightly over 1500 acres entered in 1942. Up to the present time we have about 1400 acres certified, compared with 885 acres certified at the final inspection last season.

The third inspection is well under way and will likely be completed within the next ten days. Fields are being rejected for ring rot whenever it is found in a field under inspection.

Heavy frosts have been reported in all of the mountainous counties of the state during the last several days. (Sept. 13).—K. W. LAUER.

SOUTH DAKOTA

Digging of potatoes is now under way in South Dakota (September 11). Yields are very good, ranging from 175 to 250 bushels per acre. The tubers harvested to date are slightly green and "feather" easily. Shipments of certified stock have been made to Cuba, Hawaiian Islands and Florida.

Some table stock has been loaded, going at the support price of $1.80 per cwt. for U. S. No. 1. The potato acreage in South Dakota is estimated at 51,000. Four thousand eight hundred and seventy-five acres were entered for certification. The bulk of the commercial acreage of potatoes is in the northeastern part of the state around Watertown.

Estimates have been made indicating that between 400 and 500 cars of potatoes will be shipped from South Dakota this fall, in addition to the potatoes going into storage for winter and spring delivery.

Only a small acreage of "War Approved Seed" was entered for certification, since the plants were too mature in most fields to make an inspection.

South Dakota will have some very fine quality certified Bliss Triumph and Irish Cobbler seed stock this season. The table stock quality is also good. Very little scab or wire worm injury has been found to date. (Sept. 11).—JOHN NOONAN.

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RELATION OF RATE AND PLACEMENT OF FERTILIZER, VARIETY, SEED SPACING, AND SIZE OF SEED-PIECE TO YIELDS OF POTATOES[1]

Ora Smith, R. F. Hommel and W. C. Kelly

Department of Vegetable Crops, Cornell University, Ithaca, N. Y.

Because of current interest in the application of fertilizer for potatoes to a greater depth in the soil than the standard equal-depth band placement, and because of requests from many growers for such information, the following data preliminary in nature, are presented. Owing to the many interesting factors which are involved in such a study, consideration was given to the amounts of fertilizer applied, sizes of seed pieces planted, distances of spacing seed-pieces in the row, and responses of varieties in addition to the methods of fertilizer placement.

Materials and Methods

In 1942, three methods of fertilizer placement were compared: (1) all applied through the planter in equal-depth bands; (2) all applied through the planter in high-low bands; and (3) one-half broadcast, plowed under and one-half applied through the planter in high-low bands. The rate of application per acre at each of these placements was (1) 40 lbs. N, (nitrogen) 80 lbs. P_2O_5 (phosphoric acid) and 80 lbs. K_2O, (potash) the equivalent of 800 pounds 5-10-10, and (2) 80 lbs. N, 160 lbs. P_2O_5 and 160 lbs. K_2O, the equivalent of 1600 pounds of 5-10-10. Two varieties were used at each of the above treatments, (1)

[1]Published as Paper No. 256, Department of Vegetable Crops, Cornell University, Ithaca, New York.

Sebago and (2) Pioneer Rural. Seed spacing in the row at each of the above treatments was (1) 11 inches and (2) 14 inches, and sizes of seed-pieces at each of these treatments were (1) 1¼ ounces and (2) 2 ounces. The broadcast applications of fertilizer were made on the 11th of May, 1942. Rye cover crop preceded the potatoes. The potatoes were planted on the 27th, 28th and 29th of May, 1942, with no rainfall intervening, in 33-inch rows on Palmyra gravelly silt-loam soil. The growing season rainfall was considered adequate and well distributed for good growth of potatoes. The nitrogen source of the fertilizer was 50 per cent $(NH_4)_2SO_4$, (ammonium sulphate) 25 per cent $NaNO_3$ (sodium nitrate), and 25 per cent Uramon. The P_2O_5 source was 20 per cent superphosphate, and the K_2O (potash) was 60 per cent KCl (potassium chloride). The mixture was neutralized with ground limestone. This was a factorial experiment with 3x2x2x2x2=48 treatments and with two replications. Plots consisted of 5 rows, each 45 feet long, the inner three rows being harvested for records.

Results

A summary of the yields of methods of fertilizer placement, rate of fertilizer application, and varieties as an average of two sizes of seed-pieces and two distances of spacing is presented in table 1.

Table 1—*Effects of fertilizer placement, rate of fertilizer application, and variety on yields of potatoes.*

Fertilizer & Rate per Acre	U. S. 1 Size (Bushels per Acre)					
	SEBAGO			PIONEER RURAL		
	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands
800 lbs. 5-10-10	286	270	247	260	274	217
1600 lbs. 5-10-10	271	320	311	261	290	276

With the equal-depth band application of 1600 pounds at time of planting, the yields are no higher than with the 800-pound application; in fact, with the Sebago, it was somewhat lower. This indicates possible injury to the plants with the high rate of application under the condi-

tions of this experiment. This is further indicated by the much larger yields obtained at the 1600-pound application from the high-low band method and the one-half broadcast, one-half band application than from the equal-depth band placement.

At the 800-pound per acre rate of application, highest yields of Sebagos were obtained from equal-depth band application and lowest from the broadcast-band method; whereas, with the Rural, highest yields were obtained from the high-low band, and lowest from the broadcast-band method. The Sebago outyielded the Rural at both rates of application and with every method of fertilizer placement except the high-low band at 800 pounds to the acre where yields were practically the same.

The differences in yields between the three methods of placement, two varieties, and two distances of spacing seed-pieces as an average of the two rates of fertilizer application and two sizes of seed-pieces are shown in table 2.

TABLE 2—*Effects of fertilizer placement, variety, and distance of spacing seed-pieces on yields of potatoes.*

Spacing of Seed-pieces	U. S. 1 Size (Bushels per Acre)					
	SEBAGO			PIONEER RURAL		
	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands
11 inches	312	308	294	274	278	247
14 inches	245	283	264	246	286	246

When presented in this form, the data show that yields from various distances of spacing seed-pieces in the row are influenced by method of placement of fertilizer. With the Sebago and at 11-inch spacing, highest yields are obtained from equal-depth band and high-low band methods of placement. At the 14-inch spacing, yields are highest with the high-low band placement and lowest at the equal-depth band placement. The results with the Pioneer Rural are very similar to those with the Sebago, except that the method of one-half broadcast, one-half in bands did not yield as well comparatively as it did with the Sebago variety.

Yield differences between the methods of placement, rate of appli-

cation of fertilzer and size of seed-piece as an average of the two varieties and two distances of spacing are presented in table 3.

TABLE 3—*Effects of fertilizer placement, rate of fertilizer application, and size of seed-piece on yields of potatoes.*

Fertilizer & Rate per Acre	U. S. 1 Size (Bushels per Acre)					
	1-¼ Oz. Seed-pieces			2 Oz. Seed-pieces		
	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands
800 lbs. 5-10-10	262	267	230	284	277	234
1600 lbs. 5-10-10	247	304	287	285	306	300

These results indicate that with small-size seed-pieces and placement of fertilizer in equal-depth bands, there is probably some injury from the 1600-pound rate compared with the 800-pound rate of application. With large seed-pieces, yields at the two rates of fertilizer application in equal-depth bands are the same. With the high-low band and one-half broadcast, one-half band methods of placement and with 2-ounce seed-pieces, yields are considerably higher with the 1600 than with the 800-pound per acre rate of application. With small seed-pieces

TABLE 4—*Effects of fertilizer placement, size of seed-pieces and seed spacing on yields of potatoes.*

Spacing of Seed in the Row	U. S. 1 Size (Bushels per Acre)					
	1-¼ Oz. Seed-pieces			2 Oz. Seed-pieces		
	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands
11 inches	289	285	266	297	300	274
14 inches	220	287	251	272	282	259

and at both rates of fertilizer application, the best placement of fertilizer appears to be the high-low band method.

Yield differences between methods of placement, size of seed-pieces and distances of spacing seed in the row as an average of two varieties and two rates of fertilizer application are presented in table 4.

With the high-low band method of placement, yields were consistently high regardless of the size of seed-pieces or distance of spacing. Yields from the method of placement of one-half broadcast, plowed under, one-half bands were consistently low at both spacings and both sizes of seed-pieces. At the 14-inch spacing of the small seed, equal-depth band placement resulted in low yields.

Yields obtained at the three methods of placement, two rates of fertilizer application and two distances of spacing seed-pieces as an average of both varieties and two sizes of seed-pieces are presented in table 5.

TABLE 5—*Effects of fertilizer placement, rate of fertilizer application, and distance of spacing seed on yields.*

Fertilizer & Rate per Acre	U. S. 1 Size (Bushels per Acre)					
	11-inch spacing			14-inch spacing		
	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands	Equal-depth Bands	Hi-lo Bands	½ Broadcast ½ Bands
800 lbs. 5-10-10	300	274	241	247	270	223
1600 lbs. 5-10-10	286	311	300	245	299	287

These results show that with close spacing and at the rate of 800 lbs. 5-10-10 to the acre, equal-depth band placement resulted in higher yields than from the two other methods of fertilizer application. At the 1600-pound per acre rate of application and the same spacing, however, equal-depth band placement of fertilizer resulted in lowest yields and high-low band placement resulted in highest yields. With the 14-inch spacing, the high-low band method of placement resulted in largest yields at both rates of fertilizer application. No increases in yields with equal-depth band placement resulted from the 1600-pound application of fertilizer over the 800-pound rate; whereas, large increases resulted when applied in either of the other two methods.

Yield differences obtained from several rates of fertilizer application, varieties, and sizes of seed-pieces as averages of three methods of fertilizer placement and two distances of spacing seed-pieces are shown in table 6.

TABLE 6—*Effects of rate of fertilizer application, variety, and size of seed-piece on yields of potatoes.*

Fertilizer & Rate per Acre	U. S. 1 Size (Bushels per Acre)			
	SEBAGO		PIONEER RURAL	
	1-¼ Ounce	2 Ounce	1-¼ Ounce	2 Ounce
800 lbs. 5-10-10	254	282	252	249
1600 lbs. 5-10-10	283	318	276	275

The value of large-size seed-pieces in Sebago plantings as compared with the Pioneer Rural is shown here. The yields of both varieties from plantings of small seed-pieces and with the same rate of fertilizer application are almost the same; whereas, the yields of the Sebago variety from large seed-pieces increase appreciably over the small seed-pieces, whereas yields from large seed-pieces of the Pioneer Rural remain the same as with small seed-pieces. With both varieties and at both sizes of seed-piece, yields are increased by doubling the fertilizer application. The greatest increases and highest yields are obtained with 2-ounce seed-pieces of the Sebago variety and with the higher rate of fertilizer application.

In table 7 data are presented showing yield differences obtained from several rates of fertilizer application, varieties, and distances of spacing seed-pieces as averages of three methods of fertilizer placement and two sizes of seed-pieces.

The importance of closer spacing of seed-pieces of Sebago is shown by the large increases in yields of U. S. 1 size tubers from 11-inch compared with 14-inch spacing. With the Rural, yields are practically the same with both distances of spacing. Doubling the fertilizer application with the Sebago variety has resulted in slightly larger increases in yields than with the Pioneer Rural.

TABLE 7—*Effects of rate of fertilizer application, variety, and distance of spacing seed-pieces on yields of potatoes.*

Fertilizer & Rate per Acre	U. S. 1 Size (Bushels per Acre)			
	SEBAGO		PIONEER RURAL	
	11-In. Spacing	14-In. Spacing	11-In. Spacing	14-In. Spacing
800 lbs. 5-10-10	288	247	255	245
1600 lbs. 5-10-10	321	280	277	274

.Data showing yield differences between rates of fertilizer application, varieties, sizes of seed-pieces, and distances of spacing seed-pieces as averages of three methods of fertilizer placement are presented in table 8.

Increases in yields from fertilizer applications of 1600 pounds to the acre over those of 800 pounds varied from three to 43 bushels, depending upon the other factors involved. With both varieties, lowest yields were obtained from the combination of lower rate of fertilizer application, the smaller size seed-piece, and the greater distance of spacing seed-pieces. Largest yields of Sebago resulted from the combination of closer spacing, the larger size seed-piece, and the larger application of fertilizer. Highest yields of the pioneer Rural are not so clear-cut as to treatments as with the Sebago. With both varieties, yields average slightly higher, but probably not significantly higher from the use of 1¼-ounce seed-pieces spaced 11 inches apart than from 2-ounce seed-pieces spaced 14 inches apart. The former method requires 22,5 bushels of seed to the acre, whereas the latter method requires 28.3 bushels.

With the Sebago, large increases in yields result from the use of large-size seed-pieces closely spaced compared with small seed-pieces spaced farther apart. With the Pioneer Rural, the response to these factors is not consistent and therefore they are not considered so important as with the Sebago and perhaps some of the other newer varieties.

The data presented in table 9 show yield differences between rates of fertilizer application, methods of fertilizer placement, varieties, sizes of seed-pieces, and distances of spacing seed-pieces.

TABLE 8—*Effects of rate of fertilizer application, variety, size of seed-piece, and distance of spacing seed-pieces on yields of potatoes.*

Fertilizer and Rate per Acre	U. S. 1 Size (Bushels per Acre)							
	SEBAGO				PIONEER RURAL			
	11-Inch Spacing		14-Inch Spacing		11-Inch Spacing		14-Inch Spacing	
	1-¼ Oz.	2 Oz.	1-¼ Oz.	2 Oz.	1-¼ Oz.	2 Oz.	1-¼ Oz.	2 Oz.
800 lbs. 5-10-10	280	296	228	267	267	244	238	253
1600 lbs. 5-10-10	304	338	263	298	270	284	281	267

With applications of 800 lbs. 5-10-10 fertilizer, the Sebago variety yielded from 215 bushels to the acre, with small seed-pieces spaced 14 inches apart and with the fertilizer placed in equal-depth bands or one-half broadcast-one-half bands, to 336 bushels with large seed-pieces spaced 11 inches apart and with the fertilizer placed in equal-depth bands. This indicates the great importance of size and spacing of seed with the Sebago. This is an increase in yield of 121 bushels to the acre obtained by using 2-ounce rather than 1¼-ounce seed-pieces and spacing 11 inches rather than 14 inches in the row. The amount of seed necessary to plant an acre with 1¼-ounce seed-pieces spaced 14 inches apart is 17.7 bushels, whereas 36.0 bushels are necessary to plant an acre with 2-ounce seed-pieces spaced 11 inches apart. By the use of 18.3 bushels additional seed tubers, yields were increased 121 bushels. Similarly, at the 1600-pound per acre application with equal-depth band method of placement, by spacing the Sebago 2-ounce seed-pieces 11 inches apart, the yields were increased 91 bushels above those from 1¼-ounce seed-pieces spaced 14 inches apart.

As stated previously, the response of the Pioneer Rural to close spacing and the use of large-size seed is less consistent than with the Sebago.

Especially with the Sebago there is indication of some possible injurious action of the 1600-pound per acre application when all was applied in equal-depth bands. At the four combinations of size of seed-piece and distance of spacing and with equal-depth band placement of fertilizer, there was an average decrease in yield of 16 bushels to the acre by the use of 1600 pounds compared with 800 pounds 5-10-10 to the acre. However, with high-low band placement, there was an increase of 50 bushels to the acre; and with the one-half broadcast-one-half band placement, there was an increase of 64.5 bushels. The responses of the Pioneer Rural to these factors were not so consistent nor so marked. The results of these experiments further substantiate our observations and results from other experiments in indicating that the Pioneer Rural and the Rural group in general are less responsive to changes in environment or cultural practices than the Sebago and some of the other newer varieties.

Results from this preliminary study would indicate that there is some merit in the deeper application of commercial fertilizers for potatoes at least on certain soil types and under certain environmental conditions; also that heavier applications of fertilizer may be applied profitably when the fertilizer is placed deeper in the soil or farther from the

TABLE 9—*Effects of rate and placement of fertilizer, variety, size of seed-piece, and distance of spacing seed-pieces on yields of potatoes.*

Fertilizer and Rate per Acre	U. S. 1 Size (Bushels per Acre)											
	SEBAGO											
	11-Inch Spacing						14-Inch Spacing					
	1-¼ Ounce			2 Ounce			1-¼ Ounce			2 Ounce		
	A	B	C	A	B	C	A	B	C	A	B	C
800 lbs. 5-10-10	320	264	256	336	270	283	215	254	215	275	293	233
1600 lbs. 5-10-10	284	340	287	307	358	350	216	278	293	275	305	315
	PIONEER RURAL											
800 lbs. 5-10-10	294	271	235	249	294	189	220	280	214	277	262	230
1600 lbs. 5-10-10	259	266	286	296	281	276	227	334	283	262	279	259

A = equal-depth bands
B = high-low bands
C = ½ broadcast, ½ bands

seed-piece as compared with equal-depth band placement. With the Sebago and possibly others of the newer varieties, much larger yield responses are obtained from close spacing and the use of large seed-pieces than with the Rural and possibly other old standard varieties.

THE RESISTANCE OF THE SEBAGO VARIETY TO YELLOW DWARF[1]

G. H. Rieman and J. S. McFarlane

University of Wisconsin, Madison, Wis.

Introduction

Yellow dwarf, a potato virus disease characterized by a stunting and yellowing of the plant and by the malformation and necrotic flecking of the tubers, occurs in frequent but sporadic epidemics throughout Central Wisconsin, Walker and Larson (4). Severe losses occur as a result of reduced yields and from the reduced marketability of the remaining potatoes. The virus has been shown by Black (1) to carry over from year to year in (1) the potato tuber and (2) the clover leafhopper, *Aceratagallia sanguinolenta* Prov., or in some host other than the potato. The greatest loss occurs to the grower through the use of infected seed. It is not uncommon to find seed stocks with fifty per cent or more infected tubers. Unfortunately, the virus content of a seed stock cannot be accurately predicted by tuber symptoms or by vine symptoms of the previous crop. The only practical, positive manner of avoiding loss from tuber-borne infection in the yellow dwarf-susceptible varieties is through the use of northern-grown, yellow dwarf-free seed.

The introduction and general use of an adapted, yellow dwarf-resistant variety would not only eliminate the necessity of changing seed stocks each year, but would also do much to improve the marketability of the potatoes by eliminating the necrotic tuber flecking which may result from either the past season or current season spread of the yellow dwarf disease.

Review of the Literature

Varietal differences in yellow dwarf incidence have been reported. Fernow and Black (2) found that yellow dwarf was more abundant in Green Mountain than in Rurals even when the two varieties had been

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[1]Contribution from the Wisconsin Agricultural Experiment Station. Paper No. 316 from the Department of Genetics.

grown together for several years. However, all varieties were found to be subject to infection. Wheeler (5) reported that several potato seedlings failed to show disease either as a result of exposure to heavy field infection or from plug grafting.

Taylor (3), in studying the behavior of nine varieties, observed a range from 1.6 to 48.4 per cent infection. Of the standard varieties, Russet Burbank and Irish Cobbler showed the lowest incidence of disease, whereas Columbia Russet and Pioneer Rural showed the highest infection. Taylor concluded that the variation in incidence of yellow dwarf is caused either by varietal susceptibility or by klenducity; that is, some varietal characteristic which affects the rate at which effective inoculation occurs.

Walker and Larson (4) report that of nineteen varieties or strains of potatoes grown in Central Wisconsin during the 1937 epidemic, Russet Burbank produced distinctly the lowest number of missing hills and yellow dwarf plants.

Material and Methods

Previous investigations at this station have indicated that the new Sebago variety possesses field resistance to the yellow dwarf virus. In 1941 a two-year experiment was started in the yellow dwarf area of Central Wisconsin with the purpose of determining the value of the Sebago variety for commercial production and for plant breeding purposes. Sebago was tested against the standard Russet Rural variety on nineteen representative farms embracing a wide range of growing conditions. The seed used in these tests was obtained from the Wisconsin Foundation Seed Farm and was known to be free from yellow dwarf. Two rows of each of the varieties were planted by each of the nineteen growers in a field of his regular potatoes. On most farms the plantings were made in Russet Rural fields which had been planted from seed produced on the particular farm the previous season. The occurrence of yellow dwarf in the farmers' fields was determined during the growing season. One-bushel samples of each of the test varieties were collected at harvest time and placed in suitable common storage. During the winter months the yellow dwarf spread was determined on five Russet Rural and five Sebago samples in the greenhouse. This was done by removing an eye from representative tubers, as is done in tuber indexing. These eyes were germinated in a moist chamber at about 70° F. and then planted in four-inch clay pots. The plants were maintained at a temperature of about 65° F. until they were well emerged and were then transferred to an 80° F. temperature to obtain yellow dwarf expression.

TABLE I—*Comparison of yellow dwarf resistance of Sebago and Russet Rural potato varieties grown on 19 Central Wisconsin farms in 1941 and tested in the greenhouse and field in 1942*

Farm No.	Per cent Yellow Dwarf in Farmer's Field	Russet Rural: Total Plants Tested		Russet Rural: Yellow Dwarf Plants		Russet Rural: Missing Plants		Russet Rural: Per cent Yellow Dwarf		Sebago: Total Plants Tested		Sebago: Yellow Dwarf Plants		Sebago: Missing Plants		Sebago: Per cent Yellow Dwarf	
		G.H.[1]	Field	G.H.	Field	G.H.	Field	G.H.	Field	G.H.	Field	G.H.	Field	G.H.	Field	G.H.	Field
1	trace	—	100	—	18	—	0	—	18	—	100	—	0	—	0	—	0
2	0	98	83	2	2	3	6	2	2	79	75	0	0	0	7	0	0
3	15-20	91	100	53	46	11	0	58	46	76	100	0	0	0	0	0	0
4	0	—	100	—	5	—	0	—	5	—	17	—	0	—	0	—	0
5	0	—	100	—	3	—	0	—	3	—	85	—	1	—	1	—	1
6	2-5	—	89	—	36	—	0	—	40	—	81	—	1	—	0	—	1
7	0	—	88	—	2	—	0	—	2	—	100	—	0	—	0	—	0
8	25-30	97	100	52	51	1	2	54	51	108	100	1	1	—	0	1	1
9	trace	120	100	1	2	8	0	1	2	120	100	0	0	0	2	0	0
10	20-25	58	57	25	22	13	10	43	39	51	47	2	2	0	10	4	4
11	5-10	—	100	—	15	—	2	—	15	—	74	—	0	—	0	—	0
12	2-5	—	100	—	4	—	0	—	4	—	100	—	0	—	0	—	0
13	5-10	—	76	—	9	—	0	—	12	—	52	—	0	—	0	—	0
14	5-10	—	81	—	20	—	0	—	25	—	77	—	0	—	1	—	0
15	trace	—	100	—	2	—	0	—	2	—	100	—	0	—	1	—	0
16	trace	—	100	—	37	—	1	—	37	—	100	—	0	—	1	—	0
17	0	—	100	—	12	—	1	—	12	—	100	—	0	—	0	—	0
18	0	—	45	—	0	—	0	—	0	—	36	—	0	—	0	—	0
19	trace	—	100	—	16	—	0	—	16	—	100	—	2	—	0	—	2
Total			1719		302		22		17.6		1544		7		23		0.5

[1]Greenhouse.

Samples from the nineteen farms were tested in the field at the Hancock Branch Experiment Station during the following season. The plantings were made early to favor the development of plants from yellow dwarf infected tubers. This was considered important since Walker and Larson (4) have shown that non-emergence of plants from yellow dwarf infected tubers is associated with high soil temperatures. Low soil temperatures prevailed for a period of a month following planting and high emergence occurred in 34 of the total 38 test plantings.

In 1941 an F_1 population from a Sebago x Hindenburg cross and a certified lot of Russet Rural were exposed to yellow dwarf infection in Central Wisconsin. Tubers from the exposed F_1 plants and from the Russet Rural variety were saved and planted the following year at the Hancock Branch Experiment Station where observations were made on the spread of yellow dwarf.

Experimental Results

The results of the Sebago and Russet Rural tests presented in table 1 show that the yellow dwarf spread varied considerably from farm to farm. Farm No. 18 showed no yellow dwarf spread in either the Sebago or Russet Rural varieties; whereas, Farm No. 8 showed 51 per cent in the Russet Rural and one per cent in the Sebago variety. In general, the yellow dwarf spread was most severe when the test varieties were grown in fields showing some yellow dwarf infection.

On none of the farms was the spread of yellow dwarf to the Sebago variety found to be greater than the spread to Russet Rural. On Farm No. 3 the previously yellow dwarf-free Russet Rural stock picked up 46 per cent yellow dwarf after a single year's exposure, whereas the healthy Sebago variety growing alongside of the Russet Rural did not become infected with yellow dwarf. Only one-half of one per cent of the Sebago plants grown on these nineteen farms became infected with yellow dwarf, but approximately eighteen per cent of the Russet Rural plants became infected with the disease.

The number of missing plants was low in all lots with the exception of those from Farms No. 2 and 10. The poor emergence in these four lots may be explained by the poor physical condition of the seed. The tubers had been previously used in the greenhouse test which weakens them for the field test. Missing plants were not considered as yellow dwarf plants in the analysis of the results.

The results as presented in table 2 indicate that the F_1 population of a cross between Sebago and Hindenburg is less readily infected with yellow dwarf than is the Russet Rural variety. The Russet Rural va-

riety showed 40 per cent infection, whereas under similar conditions the F_1 population showed only seven per cent infection.

Discussion and Conclusions

The high field resistance of Sebago to yellow dwarf infection is clearly demonstrated by its superior performance on the nineteen co-

Table 2—*Comparison of yellow dwarf resistance of an F_1 population from a Sebago x Hindenburg cross with the Russet Rural variety grown at Wild Rose, Wisconsin, in* 1941 *and tested in the field in* 1942

Variety or Parentage Dwarf	Per cent Yellow Dwarf in Test Plot	Total Plants-Tested	Yellow Dwarf Plants	Missing Plants	Per cent Yellow Dwarf
Russet Rural	2-5	20	8	0	40
Sebago x Hindenburg	"	85	6	0	7

operating farms, representing a wide range of growing conditions in the yellow dwarf area of Central Wisconsin. The results make it clear, however, that Sebago is not immune to yellow dwarf. Infection ranged from zero to two per cent, with an average of one-half of one per cent. The plant symptoms were as distinctive on the infected Sebago plants as on Russet Rural, thus indicating that after infection occurs, the progress and behavior of the virus is comparable in the resistant and susceptible varieties.

Although no attempt was made to determine the nature of resistance, certain suggestions are possible from the results. The fact that the tests were conducted on nineteen different farms under a wide range of environmental and cultural conditions indicates that the low incidence of yellow dwarf in the Sebago variety is not a case of disease escape. The behavior of the virus following its entrance into the host plant suggests that resistance may be associated with the exclusion of the virus. It is possible that the Sebago variety is avoided by the insect vector or vectors of the yellow dwarf virus. Walker and Larson (4) suggested this as a possible explanation of the low incidence of yellow dwarf in the Russet Burbank variety.

The significance of the high field resistance of the Sebago variety to the potato growers in a yellow dwarf area such as Central Wisconsin

is two-fold. In the first place, it has been demonstrated that seed of the Sebago variety produced in the yellow dwarf area may be used with satisfactory results the second year. Indications are that a Sebago seed stock may be maintained with safety for even a longer period in this area. With the susceptible Russet Rural variety, it is impractical to replant home grown seed for even one year. Secondly, the market value of the Sebago variety is distinctly greater than that of the Russet Rural. This is attributed in part to the freedom of the Sebago tubers from the brown necrotic flecking characteristic of yellow dwarf-susceptible varieties. Tubers so infected appear normal until cut and cannot be picked out on the sorting table.

The good agreement between greenhouse and field results indicates that yellow dwarf expression is characteristic under greenhouse conditions. By carefully controlling temperature relationships, more consistent results may be expected in the greenhouse than in the field.

Evidence that yellow dwarf resistance is inherited is shown by the F_1 population from a Sebago x Hindenburg cross. This population exhibited a markedly higher resistance than did the susceptible Russet Rural variety. Although no data were secured on the behavior of the Hindenburg variety under the conditions of this particular test, previous tests have shown that it is susceptible to yellow dwarf. Therefore, the resistance shown by this F_1 population was probably derived from the yellow dwarf-resistant Sebago variety.

Summary

The Sebago and Russet Rural varieties were compared for yellow dwarf resistance on nineteen representative farms in the yellow dwarf area of Central Wisconsin.

The high field resistance of Sebago is demonstrated by the fact that only one-half of one per cent of the plants grown on the nineteen farms became infected; whereas approximately eighteen per cent of the Russet Rural plants became infected under similar conditions.

The Sebago variety is not immune to yellow dwarf. Infected plants show characteristic symptoms. An avoidance of the Sebago variety by the insect vector or vectors is suggested.

Yellow dwarf spread may be accurately determined in the greenhouse.

The inheritability of yellow dwarf resistance is demonstrated by the low incidence of yellow dwarf in an F_1 population from a cross between the resistant Sebago variety and the susceptible Hindenburg variety.

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CONCERNING "LOST" POTATO ACRES

B. E. Brown[1]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, Washington, D. C.

Introduction

One of the biggest jobs facing America at the present time, and undoubtedly for some time to come, is the production of food—food for our armed forces, for our civilian population, and for our allies. One of our most important food crops is the potato. The consumption of potatoes is reported to be on the increase because: (1) More people are at work, many of whom are doing harder work than heretofore, as a result of which there is greater spending power, as well as more need for energy-producing food, which the potato helps to supply; and (2) there is greater consumption of fresh and dehydrated potatoes on the part of the armed forces, who no doubt eat considerably more potatoes per man than when engaged in peacetime pursuits.

The need for an ample supply of potatoes can hardly be overemphasized in wartime. A lost crop of potatoes not only means an actual loss of food but a loss as well of time, labor, seed, and any fertilizer used. Such an experience must be bitterly disappointing to a potato grower who tried to do his utmost to produce a crop and failed because of adverse conditions.

Basis of Present Article

In looking up potato production statistics recently, the writer noted some statistics that were of sufficient interest to warrant consideration. The figures are given in adjoining columns[2] in "Agricultural Statistics,

[1]Senior biochemist.
[2]Table 383, p. 299.

1942", issued by the United States Department of Agriculture. The first column is headed "Acreage planted", the second, "Acreage harvested". These records run continuously from 1929 to 1941.

Taking the recorded figures as a basis, the average acreage of potatoes planted for the 12-year period 1929 to 1940 was 3,300,667; the average acreage harvested was 3,236,834. This means that on an average 63,833 acres planted to potatoes were unharvested. The range in "lost" acres varied from a low of 22,000 acres in 1929 to a high of 163,000 in 1934[3]. The average yield per acre for the 12-year period was 114 bushels.

Perhaps, offhand, one would be inclined to dismiss the loss as a "normal" one, the result of various hazards, natural or otherwise, as well as of low prices. It is true that the loss is just about 2 per cent of the total acreage planted,[4] but if one should express this in terms of actual bushels of potatoes, the loss seems more impressive. Assuming that these "lost" acres might have yielded at the average rate of 114 bushels per acre the loss in production would have been something more than 7¼ million bushels. If a lower average yield is taken, say 80 bushels per acre, the loss would still be a little more than 5 million bushels—enough to feed approximately 2 million consumers before the war.

While there is no intention on the part of the writer of implying there should be no loss at all, nevertheless a pertinent question arises as to whether an acreage loss as large as that reported is entirely justifiable. Would, for example, experienced growers in Aroostook County, Maine, on Long Island, or in New Jersey, Pennsylvania, Virginia, and elsewhere condone a loss year after year of 2 acres out of a hundred planted because of poor soil conditions? If such a loss occurred for a single year it is the opinion of the writer, based on year-by-year contacts with many growers, that the cause of the trouble would be promptly and effectively removed.

What Causes Likely Contribute to Acreage Losses?

Two kinds of factors are likely involved: (1) Controllable and (2) uncontrollable. Under (1) fall the various practices left to the judgment of the potato grower himself. Under (2) the so-called natural hazards arising primarily from floods, hail, drought, freezes, and, to some extent, windstorms.

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[3]In 1929 prices received by potato farmers averaged high; in 1934, low prices prevailed. It is to be hoped that in 1943 the "lost" potato acres will be "found."

[4]As many growers would sustain no loss at all, it is self-evident that the loss of the other less fortunate growers would average much more than 2 per cent.

Considering briefly some of the controllable factors certain questions arise:

(1) Was the site suitable for growing potatoes?
This would refer especially to whether the land was subject to overflow or serious washing. If so, there seems no valid reason for planting potatoes on such land. If the prospective crop is lost as a result of excessive flooding or washing, any money spent for seed or fertilizer is so much wasted. It is bad enough to plant heavy, poorly drained land with tight subsoil or deep, quick-drying, sandy land; but it is much worse to use soil subject to the direct water hazards pointed out above.

(2) What about the seed bed? Was it deep and well prepared, so as to insure retention of rainfall, root penetration, and good tuber shape?

(3) Was good disease-free seed (certified) used rather than disease-ridden stock? Was the seed stock stored properly to prevent deterioriation? Was it cut and handled properly to planting time? Was the variety planted adaptable to the environmental conditions?

(4) Was fertilizer used? If so, was it so applied as to avoid injury to the seed piece?

(5) Was spraying efficiently conducted in order to control fungous diseases and insect pests? Were dump piles avoided?

(6) Was the crop properly taken care of with respect to cultivation and other cultural operations?

(7) In sections where common scab is troublesome and the potato crop may lose considerable commercial value as a result thereof, are there scab-resistant varieties for trial? Is the degree of scabbing in such cases too great to warrant soil treatment? Or, would a combination of the two—soil treatment and growing a scab-resistant variety—offer greater insurance against scab?

The foregoing probably are of most concern to the potato farmer. If one or more of them is neglected, disappointing results may likely follow and a contribution to the "lost" acres made possible.

Considering next the so-called uncontrollable factors, the matter of rainfall, either excessive or deficient, is important. Prolonged rains falling on land unsuited for potatoes may cause total loss of crop

through prolonged flooding or washing[5]. Seed pieces subjected to undue submergence may rot or develop weak plants incapable of forming merchantable tubers. As a result, another contribution to the "lost" acres. Planting potatoes on such unsuitable land is a distinct gamble and should be avoided.

Prolonged drought is a serious factor, especially if potatoes are planted on too-light soil or on soil lacking in humus. Such soils are reputed to dry out faster than those containing plenty of actively decaying organic matter. In this connection, these questions might be raised: Is there a potato variety more drought-resistant than the one being grown? Or, could perhaps another crop relatively more drought-resistant than the potato be grown more advantageously? In Aroostook County, Maine, the writer has observed that Irish Cobbler, in comparison with Green Mountain, suffers more from drought[6], and as a result produces relatively a lower yield when grown under abnormally dry conditions, whereas the Green Mountain grown in Aroostook County usually continues to "take it" until the drought is over and then proceeds to make a very satisfactory yield. Again, in Pennsylvania the Russet Rural can take a beating from drought and still finish the season with fairly high yields. No doubt the extent of root and foliage development is important in drought resistance, as well as the time and duration of the drought in relation to tuber setting.

Either excessively low or high temperature affects potato plants adversely. Freezing temperature may lead to acreage losses. More often, however, the trouble involves delayed coming-up due to killing back, followed, in many cases, by subsequent recovery. Excessively high temperature causes rapid loss of moisture directly from the soil and through the plant foliage. To some extent timely cultivation and spraying appear to ameliorate this condition, as well as a deep, well-prepared seed bed to encourage root penetration. Drought can be controlled through irrigation, if practicable to install a system.

It will be of interest to present the views of two men who for years

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[5]Some loss, particularly from regional flooding, probably is unavoidable. The acreage lost this year in the Middle West from overflowing rivers, such as might occur one year in 25, could not logically be ascribed to a short-sighted practice on the part of the potato grower. Nevertheless, in the years when no such floods occur there is a persistent, one might call it "chronic", loss of potato acreage. It will therefore be of considerable interest to see what the status is for 1943, a year when every effort will be made to harvest the crop for patriotic reasons; also a year when the grower is assured of a fairly good financial return for his efforts to help attain the potato production goal set for all potato farmers in 1943.

[6]Due primarily to difference in time of "setting" tubers, the critical period in the life of the potato plant. A late July or early August drought in Aroostook County, Maine, affects the Cobbler more adversely than the Green Mountain.

have been intimately concerned with and have an appreciation of the problems involved in potato production and marketing. One of them, Dr. William H. Martin, Director of the New Jersey Agricultural Experiment Station, in response to an inquiry by the writer on the subject of "lost" potato acres stated in a letter:

> "I have always been interested in the fact that here in New Jersey and on Long Island a very large percentage of the potato crop is sold as compared with other areas. Of course, in New Jersey and on Long Island we are very close to large markets, and there is always a buyer for almost any kind of farm product. In a year when prices are high the growers sell even their small-size potatoes at a fairly decent price; but when prices are low there is no market for them. This, however, constitutes only a small portion of the crop. In other areas, I have an idea these smaller potatoes are dumped due to lack of nearby markets, except in those areas where starch factories operate."

Mr. A. L. Mercker, Fresh Marketing Division, Fruit and Vegetable Branch, Food Distribution Administration, United States Department of Agriculture, stated:

> "Although data are lacking, it is my belief that most acreage abandonment is a direct result of disease or weather factors rather than price. As I see it, price enters into the picture only in combination with other factors. In other words, floods, freezes, and droughts by themselves probably account for most of the abandonment. A serious blight infestation alone might have the same result, either by reducing the yield to zero or to so low a level that it simply is uneconomical to dig and attempt to store the small outturn of tubers that are almost sure to rot."

Continuing Mr. Mercker's interesting comments:

> "It is under the latter circumstances that price becomes important. High price prospects will, within the judgment of the individual, induce harvesting that otherwise would not be considered. Low prices, on the other hand, or even prices not sufficiently high, will lead to abandonment of fields of low yield, very poor quality, or unusually doubtful keeping quality. Seldom, in my experience, has price alone induced abandonment of average fields of average quality. When this does happen, it can be demonstrated that the supply far exceeds demand, and that for the individual it actually may be decidedly economical to avoid harvesting potatoes that cannot be sold. In such cases, the individual would have been better

off not to have raised potatoes at all. Unfortunately, no one consistently can outguess the weather, and very few can evaluate accurately in advance the factors that influence prices."

Summation

Reference is made herein to "lost" potato acres reported as planted but not harvested. Over a 12-year period, 1929 to 1940, the average acreage "loss" amounted to 63,833 acres. Under wartime conditions, in particular, one may be justified in raising the question: Does this constitute an irreparable loss? Or, can it be cut down in large measures by the elimination of unsuitable land and the adoption of practices conceded to be proper by experienced potato growers?

To grow potatoes, a crop that appreciates suitable soil conditions and responds thereto, on unfit land usually leads to disapointment and economic loss. Not only are seed and fertilizer, which should have been utilized on better land, wasted, but time and energy are also wasted. Seemingly it would have been much better for all concerned if the time and energy so dissipated had been used to help out a neighboring farmer in growing an increased acreage on good potato land; either that, or to grow some other crop if conditions warrant the attempt.

During the wartime period, when potato growers have been urged to produce something more than 407 million bushels of potatoes in 1943, every acre of farmland that is plowed and fitted for potatoes must be counted on to produce to its greatest capacity. Every acre should be harvested. Slacker acres are unpatriotic acres. No grower can afford to start off on the wrong foot and wind up the production race defeated because he tried to grow his crop under adverse conditions. It would be much better were he to leave the seed, fertilizer, and spray materials for potato growers who do possess suitable land.

While it may be impossible to eliminate all the acreage loss sustained by commercial potato growers, nevertheless, the possibilities for reducing it would seem well worth exploring. It is hardly conceivable that any industry would choose to adopt a do-nothing-about-it policy and thereby condone a large "chronic loss."

Might it prove desirable, therefore, to ascertain where the acreage losses occur and what constitute the main underlying causes? Does the situation appear to warrant some attention and corrective effort on the part of agricultural agencies concerned with problems affecting potato production and land utilization? Or should the matter be dropped on

the assumption that the acreage losses reported are unavoidable and that to attempt to make anything out of the matter would be like trying to "Make a mountain out of a mole-hill?"

SECTIONAL NOTES

CALIFORNIA

The potato situation in Kern County at the present time is, of course, somewhat dormant as our crop has been harvested with the exception of the Tehachapi area which comprises about 3,000 acres. This area is now being harvested—part of it consists of seed stock and the remainder of commercial potatoes.

A report from Tulare County, to the north of Kern County, indicates that their acreage for the year will be about 5,000. This is a new area which is gradually developing and it may become quite a productive area in the future. A small quantity of seed stock has been grown in Tulare County for a number of years. For a more complete report on the Tulare situation, I would suggest that you write Mr. Ralph L. Worrell, Assistant County Agent, Post Office Bldg., Visalia, California.

Our potato growers have always used straight ammonium sulfate until the last two years when war conditions have forced them to use some mixed fertilizers such as 17-10-0 and 16-20-0. This type of fertilizer, of course, is forcing the grower to buy something that he neither needs nor wants. This season he may even be forced to use ammonium nitrate. Under our method of irrigating potatoes, the nitrogen in the form of nitrate will almost wholly be lost due to the leaching in the first and second irrigations. The type of irrigation in this section is such that the pumps never stop when irrigation is started for we use the following method: light irrigation in every other row applied on alternate days. This method of irrigation, of course, will leach out any form of nitrate that is used before the plant can use it. The growers are, at the present time, making protests through the local U. S. D. A. War Board as well as the state war board and are hoping that results will be forthcoming.

A tabulated report covering the potato industry in Kern County for the past several years follows. This report has been prepared merely for the purpose of showing how an industry can develop.

Facts about Kern County Irish Potato Industry

GROWTH OF INDUSTRY AS REPRESENTED BY

Year	Acres	Production 100 Lb. Sacks	Fertilizer Lbs.	Seed 100 Lb. Sacks
1915	0	0	0	0
1920	300	30,000	1,000	4,500
1925	1,500	156,000	300,000	22,500
1930	2,200	248,800	660,000	33,000
1935	8,800	2,301,000	4,825,000	132,000
1940	29,625	5,432,150	18,975,000	444,375
1943*	40,000	8,000,000	24,800,000	600,150

*Estimated.

(Sept. 21).—M. A. Lindsay.

COLORADO

The car lot movement from Colorado is running about 1,800 cars ahead of the amount shipped at this same time last year. Part of this increase is undoubtedly due to an increase in acreage of the earlier plantings, and part is undoubtedly due to a further decrease in truck movement. The market has become completely demoralized during the past week, and shippers have been unable to make any sales. Our warehouses are completely filled up, and our growers are being urged to place stock in storage wherever storage is available.

The production of certified seed will probably be slightly lower this year, not only because of heavier rejections in the case of Red McClures and Katahdins, but also because of the new outbreak of ring rot, and heavier rejections in the case of Bliss Triumph for virus diseases. The quality of the crops meeting requirements, however, will be even above the usual high standards for the state of Colorado. For the second year in succession there will be a decided shortage of one-drops, or B-size seed potatoes, because of the poor stands. In general, most of our stock is running unusually large.

Labor for harvesting is being obtained largely through two sources, to supplement the local labor supply. These two sources are war prisoners, both German and Italian, and Mexican Nationals. Very few complaints have been registered regarding the quality of this labor, and the situation seems to be much better than it was a year ago.

There is a feeling among growers in Colorado that the September crop estimate for the state is a little high, and that Colorado will probably not produce any more potatoes than it did last year, despite the in-

crease in acreage. Frost is holding off, and many potatoes are going into storage green, which will result in considerably more shrinkage and waste. There is also a growing suspicion among our growers that an effective way to roll back potato prices, at least until spring, is to place the crop estimate high enough. (Oct. 11).—C. H. METZGER.

CONNECTICUT

Reports from commercial growers indicate that yields are much lower than was anticipated earlier in the season. In at least some cases, the crop was less than one-half that of previous years. The tubers, in general, average much smaller than usual.

The chief cause for the disappointing yields was the very low rainfall. For example, the growing season (May 1-October 1) at Storrs was the fifth driest in fifty-five years. From the first of June it was third, and after the 1st of August is was the second driest. (Oct. 13). —B. A. BROWN.

IDAHO

On the 4th of October, 1943, Idaho had shipped 6,771 cars of potatoes from the current year's crop. This exceeds, by more than 2,100 the number of cars shipped from last year's crop, at the same date. It also exceeds by more than 1,000 cars, the number shipped by the 4th of October, 1941. Although these figures apparently include some intrastate shipments to dehydrators and other processors, they still reflect a wide market and demand for Idaho Russets. This large number of early shipments may ease the storage situation, also the processing and shipping for later periods in the season. The Twin Falls and the southern part of the Idaho Falls areas were still without general frosts on the 5th of October. Growers will start harvesting late potatoes in these areas during the next ten days regardless of frost. Fusarium wilt and early ripening have put some fields into condition for harvest, and these will probably be harvested first.

Extension officials in charge of the labor program report that the weather is the important factor. With favorable weather, enough labor will probably be available to harvest the crop without serious losses. Recruited labor from the southern United States and Mexico, as well as Japanese labor from local camps, and the return of Japanese from other states, together with harvest vacations for schools in prospects, gives a fairly optimistic picture from a labor standpoint. Handlers are worried concerning the labor for sorter crews.

Storage will probably be short only in a few local instances as this situation has materially improved with the volume of new storage constructed in the state.

Yields of commercial fields this year will probably not be so high as last year, and the quality, particularly of the early-planted potatoes, may not be too good. A wet, cold planting season resulting in poor stands and some severe rhizoctonia injury may show their effects. Later-planted fields, with the long fall-growing season we have had, will probably be of better yield and quality. Ring rot losses have increased somewhat but probably represent only a very small loss compared with the total crop. In years of such great increase in acreage, there are always some marginal growers, marginal land and marginal seed involved all of which reduce yields.

Supplies of certified seed will be short again this year. Even though 1,000 additional acres were entered this year as compared with that of 1942, a July frost, coupled with early fall frosts in several of the seed sections, has reduced the yields of much of the acreage. This is true both of southern Idaho and the northern Idaho areas whose seed goes mainly to Washington commercial growers. Ring rot in several of the fields has eliminated several hundred acres from certification. Plans for War Approved Seed from the War Foods Administration came too late to be much of a factor in the seed supply. A major portion of the commercial crop in the state is planted from "one year out" (one year from certification) seed and plenty of this seed can be available if growers and dealers will make arrangements to hold this type of seed until planting time. (Oct. 5).—Eugene Whitman.

INDIANA

Although the late crop of potatoes in the commercial areas in Indiana is somewhat improved compared with last month, there is still a shortage of potatoes in Indiana. Many of the smaller plantings which have been a boon to the home gardener are almost a complete failure, which means buying potatoes for winter storage. We do not anticipate a shortage of table stock and we have urged our people to supply their needs just as soon as convenient. In this way we hope to relieve the congestion both in storage and transportation. It is also interesting to note that the average consumption of potatoes *per capita* has been on the increase during the last year or so, especially here in the middle west, so that if we do not increase the acreage and yields in In-

diana, some other state will have to do it for us in the future. (Oct. 4). —W. B. Ward.

MICHIGAN

The crop that is being harvested is in good shape. The size is generally good. Our yields to a certain extent, are disappointing in some areas, even though in others they are exceptionally good. Harvesting to date has been good and has not been interrupted by rain. However, the season is somewhat later than normal, and our harvesting operations will not be completed until about the 23d of October.

Our shipments, to date, are above normal for this time of the season, coming mostly from areas that are short of storage and, therefore, making it necessary for the growers to move them.

Growers seem reluctant to take on Government loans. The main reason for this is confusion. It seems that the AAA has different interpretations in different counties, which leave questions in the growers' mind concerning the score.

Every one is very much disturbed by OPA Amendment 7RMPR 271. It is utterly impossible to comply with this regulation. It not only means complication all down the line from the shipper to the ultimate retailer, but also disrupts the usual channels of distribution which are so materially necessary with the big job of handling the largest potato crop the county has ever produced. (Oct. 13).—H. A. Reiley.

NEW JERSEY

The New Jersey crop is practically harvested and sold at the present time. Only a very small percentage has been stored, because of the fact that the growers received very favorable prices from late September to date. The October 1st Crop Report estimated the total production at 11,502,000 bushels, which is 1,366,000 or approximately 13 per cent above the production for 1942.

Since most growers have received a fair return for their potatoes this year, and sufficient labor was available in most cases, it seems quite probable that New Jersey growers will plant about as many acres of potatoes next year as they did this year. Although the cost of production will undoubtedly be greater than it was this year, on account of the increased cost of fertilizer and labor, it is quite likely that the potato price will be high enough to cover this increase in cost.

The "second crop" seed deal has been hard hit in New Jersey. Al-

though one hundred seventy-five additional acres were entered for certification this year as compared with 1942, the acreage passing both field inspections is one hundred fifty acres less than in 1942, or 396.2 acres. In addition to the low production, the season has been so dry that yields will be extremely low, resulting in a production of possibly 40,000 to 50,000 bushels. The following varieties, together with their acreage, passed both field inspections: Green Mountain, 4.5; Cobbler, 22.2; Chippewa, 46.5; Katahdins, 221.6; Sequoia, 11.7; Sebago, 21.9; Houma, 5.5; Red Skin, 32.1; and Bliss Triumph, 30.2. (Oct. 15).—J. C. Campbell.

NEW YORK

The estimate for New York 1943 potato crop for October indicated no change. By many of New York's leading growers it is felt that the estimate should have shown a considerable decrease. Dry weather prevailed very generally during the late growth period of August and September. The weather records for central New York showed September to be the driest on record. The result of this drought checked the spread of late blight and decreased the yield. However, the quality of the crop will be better than average except for the factor of immaturity. With the exception of Long Island, a high percentage of the New York crop is being harvested in an immature condition. The upstate crop is being harvested under ideal weather conditions and was in full swing during the first two weeks of October.

Various governmental agencies have made available large groups of laborers for the harvest. Generally speaking, high school children, local women, and Bahamians have given good satisfaction as potato pickers. Despite the shortage of safe storage space for the large crop reported in the northeastern states, this lack is not felt at all seriously in New York. Many new bank storages have been constructed in central and western New York this summer.

The acreage of certified seed in New York is reported to be 3,554, an increase of 50 per cent compared with that of last year. However, the average yield will be very much lower than last year's high figure. Despite our low average yield we shall probably have more certified seed than last year. Growers have expressed some concern regarding whether enough of this good seed will be conserved for the seed market. With the shortage of potatoes last spring, too much good seed was used for table stock. According to Dr. Karl Fernow, New York will have about 437 acres of War Approved seed. About one-third of the New York certified crop is Katahdin, and approximately one-fourth Green Mountain.

Whether or not the New York crop will be marketed in an orderly fashion, depends on whether or not the growers believe that the increase in support and ceiling prices from now until spring is sufficient to justify storage. (Oct. 13).—E. V. HARDENBURG.

OHIO

There has been little rain in Ohio since the first of September. The dry weather has aided materially in the harvesting of the late potato crop and most of the potatoes are now out of the ground. The set was light, and the tubers large, but the yields in many instances have been disappointing. Commercial acreage is running between two and three hundred bushels to the acre.

The demand for potatoes in Ohio has been brisk. Most farm patches and Victory gardens have had crop failures and they are buying heavily from commercial growers. In fact, many farmers have sold their entire crop at the farm. The demand from the potato chip manufacturers has been exceedingly active. Part of this demand is due to the short crop in northern Ohio and southern Michigan caused by water damage. The chip companies from Michigan are seeking supplies in Ohio.

Retail ceiling prices for out-of-state potatoes, in many instances, are higher than ceilings for Ohio potatoes. Many buyers are offering growers prices above ceiling at the farm, but there are no black markets at retail. Buyers have a 60-cent spread which is unusually high, and they are offering part of this to the grower by paying higher prices. In other words, the grower is getting a little more for his potatoes and the consumer is not paying any more.

Many growers in Ohio have already contracted for their seed for the 1944 crop. Since there is a small apple crop, some apple storages will be available for storing potatoes. Some growers will possibly have seed shipped this fall for storage in Ohio.

The Government is trying to interest dealers in storing ungraded Maine potatoes in Ohio for future sales. There is some interest, but it is too early to state how many potatoes may move under such an arrangement. (Oct. 15).—EARL B. TUSSING.

OREGON

Oregon is growing 4,000 acres of inspected seed potatoes this year, 3,450 of which is certified and 550 of which is War Approved Seed.

The leading seed varieties are Netted Gem, White Rose, and Burbank. This year the commercial crop amounts to 53,000 acres in this state with a total yield estimated at approximately 9,800,000 bushels. Earlier in the season both harvesting and storage were were very difficult problems, but because of hard work and excellent cooperation, the situation has been somewhat eased. The Klamath Basin, our leading producing area, started their harvesting operations during the forepart of this month. (Oct. 5).—CHESTER E. OTIS.

Some discussion in our magazine should be given to the new grades, "War Approved" and "Foundation Stock." Heretofore, each state's ideas for foundation stock were more or less its own business, but now a commercial slant is given by the prospective elimination of price ceilings for that grade. We think that the grade should not have price ceilings for the same reasons that ceilings should never be imposed upon purebred livestock. We also think that certification authorities should not lend themselves to any suspicion of participating in a racket.

In other words, foundation seed should be just what the name implies, and not simply another kind of certified seed. In general, it should be good enough so that a grower could usually plant it and produce certified seed from it without roguing.

I do not know whether our tenative standards would meet the high level required for foundation seed. Comments concerning the adequacy of the tentative standards will be welcomed by the writer.

Considerable seed are now being harvested. Our yields are good and the quality is also above normal. Therefore, considerable interest is being shown in the purchase of good seed for next year.

The yield of the commercial crop is somewhat below average because of the frost on the 29th of August. Some digging is now under way. The yields vary from 75 to 80 per cent of that of last year. Our weather is still too warm for storage.

Our growers are worried over U. S. No. 2 situation. There is no market in the west at present and our weather is too warm for storage,—causing loss of the crops now being harvested and sold.

Many of our growers are also concerned over the heavy potato production in Victory Gardens throughout the nation, which, combined with the extremely heavy crop, makes an abundance of potatoes available. A dehydration plant will be ready for operation during the early part of November. This plant will operate about eight months, with a capacity of about 60 tons.

Our growers are also concerned about next year's plans but the acreage no doubt will depend upon the manner in which the government carries out support price plans. (Oct. 4).—C. A. Henderson.

PENNSYLVANIA

Growers of certified seed potatoes have nearly completed the harvesting of a fine crop of seed. This crop is probably one of the largest ever produced in this state. Because of the poor set, tubers are running larger than normal. This will likely result in a higher percentage of "grade outs" than usual. Early frosts in September killed most of the potato vines in the principal seed-producing counties. Our weather conditions since that time have been ideal for harvesting. Our yields are running nearly four hundred (400) bushels per acre.

Certified seed is being quoted at $2.25 per bushel spring delivery, F. O. B. loading point. A few sales have been made for fall delivery at $2.00 per bushel.

A number of new storage houses have been erected this year and more seed than usual is going into storage.

The potato harvesting labor near the industrial areas has not been very plentiful, but in most cases, it has been adequate. School authorities have cooperated with our growers and many large crops were picked almost entirely by high school pupils. In the more isolated areas, work camps were established, and although some of this labor was not so reliable as local help, it proved to be satisfactory. Many growers have completed their harvesting operations earlier this year than in any previous year. (Oct. 16).—K. W. Lauer.

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POTATO BREEDING, GENETICS, and CYTOLOGY: REVIEW OF RECENT LITERATURE[1]

F. J. Stevenson[2]

Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, U. S. Department of Agriculture, Beltsville, Md.

The review of recent literature on potato breeding, genetics, and cytology includes these subjects: 1. Origin of the potato; 2. Australian potato breeding problems; 3. Photoperiodism in relation to tuber setting and to flower and fruit production; 4. Resistance of the potato to viruses A. X, and Y.; 5. Resistance to late blight, common scab, and fusarium; 6. Resistance to attacks of potato leafhopper and Colorado beetle; 7. Ecological, cytological, and genetic behavior of *Solanum* species and species hybrids; 8. Sterility in the cultivated potato, *Solanum tuberosum;* and 9. Colchicine experiments.

Origin of the Potato

MacMillan (16) in discussing a review of literature dealing with the origin of the potato pointed out that a solution of the problem has not yet been found. Despite the tendency to regard the cultivated potato as having originated from more than one wild species, the possibility of finding a wild plant of *Solanum tuberosum* is not excluded.

[1]Much of the material in this report, especially that concerning articles written in foreign languages, was taken from the abstracts published by the Imperial Bureau of Plant Genetics, Cambridge, England.

[2]Senior geneticist.

MacMillan (17) pointed out that next to the cereals the potato is the world's most valued food plant and is in need of improvement in several important directions. The recent Russian expedition into South America was the most far-reaching in the expanse of territory examined, and in the number of botanical decisions rendered. The necessity for further exploration in that country was brought out. The types to be looked for and the regions that should be explored were indicated. The value of new material from the breeding standpoint was emphasized, and it was stated that until the sources of breeding stock have been thoroughly explored and the possibilities of improvement exhausted, no program of improvement will be complete.

Australian Potato Breeding

Bald (2) gave a brief account of the potato breeding problems in Australia. The American variety Katahdin is being used in crosses to obtain new varieties better suited to New South Wales conditions. Strains of Carmen have been selected which vary in maturity from early to late, in yield, and in type of tuber and vine growth.

Photoperiodism

Several studies on photoperiodism have been reported. Clarke *et al.* (6) showed that spraying potato plants with dilute concentrations of alpha-naphthaleneacetamide did not increase flower or berry production of the varieties 245-25, Sebago, Irish Cobbler, or Earlaine. Sebago and Irish Cobbler produced more berries at Greeley, Colorado, than at Beltsville, Maryland, but 245-25 produced the same number at both places. Edmundson (7) grew several varieties of potatoes under four photoperiods: 9, 11, 13, and 17 hours. The plants in the 17-hour photoperiod produced the most buds for pollination and developed the greatest number of fruits and the largest weight of seed.

Stelzner and Torka (29) studied tuber setting and blooming of *Solanum acaule, S. ajuscoense, S. antipoviczii, S. chacoense, S. demissum, S. henryi, S. jamesii, S. maglia, S. polyadenium,* and *S. verrucosum.* Most of these set more tubers under short-day conditions than under long-day. The reaction to day length differed with the species. The difference in yield of tubers under short- and long-day conditions was greater in *S. demissum* than in *S. henryi.* The latter produced almost the same amount under either set of conditions. All species with the exception of *S. henryi* bloomed under long-day conditions, whereas short-day conditions had an inhibiting effect.

Studies on the effect of day length and temperature showed that short day and high temperature (+23° C.) favored tuber formation of *Solanum antipoviczii, S. kesselbrenneri, and S. chacoense.* There was however, a general increase in yield, especially in the first two species, at a temperature of +16° C. The reactions of seedlings of the various species to the effect of length of day on blooming and tuber development varied greatly.

Resistance to Viruses

Schultz *et al.* (25) report further results on breeding for resistance to viruses A and X. Some varieties are immune to virus A in the field but become infected in graft tests. Progenies differ in their reactions to this virus. Seedling 41956 and a number of selections from progenies of which it is one of the parents seem to be immune to virus X in graft or field exposure tests. Köhler (12) tested a number of varieties for reaction to the virus Y. These varieties in the order of their resistance were: Altgold, Jubel, Konsuragis, 9089, Parnassia, and Ackersegen. Increased infection of the tubers, especially in the susceptible varieties, in the later-planted series suggests a relationship between resistance to virus Y and leafroll attacks.

Resistance to Late Blight, Common Scab, and Fusarium

A number of articles have been published on late blight (*Phytophthora infestans*) investigations. Salaman (24) has given a brief account of his work and the work of others at Cambridge, England, on breeding *Phytophthora*-resistant potatoes. Varieties combining resistance to the common form of *P. infestans* with desirable economic characters were produced by crossing *S. demissum* with cultivated varieties and then backcrossing and selfing. These varieties are not resistant to the more virulent forms of the fungus. Other varieties have been produced, however, that are resistant to both biotypes of *Phytophthora*, but they do not possess all the desirable economic characters of the domestic varieties.

Müller (18) reported that the so-called W varieties combine resistance to a group A of *Phytophthora* biotypes with economic characters. It was found that the fungus is able to infect the cells of resistant types, and these cells are killed. Before this occurs, however, a toxic substance which belongs to the tannins is produced, and this substance hinders the development of the fungus. This substance is toxic also to other micro-organisms. Susceptible varieties produce this

toxic substance but at too late a stage to stop complete development of the parasite. The genes for resistance function only as accelerators of the reaction of the host to the parasite. By keeping tubers of susceptible varieties at 3° to 6° C. the development of the fungus is very slow, and the "defense necrosis" of the potato is relatively rapid. Under such conditions the parasite does not develop, and the susceptible tubers behave like resistant forms.

Lehman (15) reported that nine wild forms of *Solanum demissum* that were homozygous either for resistance or for susceptibility to races 8 or 5 or both of *P. infestans* were intercrossed in various combinations. About 23,000 seedlings were tested. The F_1 progenies of crosses between susceptible and resistant varieties were resistant. Segregations in the F_2 and backcrosses showed that resistance in this potato species is conditioned by a single mendelian gene. The mode of inheritance was the same for both races of the organism. All reciprocal crosses were alike in reaction.

Black (3) gave an account of breeding for resistance to late blight in Scotland. Using *Solanum demissum* as the blight-resistant parent and by repeated backcrossing with cultivated varieties, resistant selections have been found in the sixth and seventh generations that compare favorably with cultivated varieties. About 40 per cent of the progeny in later generations are blight-immune. Only one strain of blight has so far been found in that country.

Hawkes and Howard (8) showed that a potato that Salaman had grown under the name "Aya papa", reported to have come from Ecuador, is immune from blight. Knappe's original collection of Aya papa was found, by other workers, to be susceptible. Salaman's Aya papa has been shown by the authors to be pentaploid ($2n = 60$-62) and to be similar in some respects to *Solanum demissum*. They suggest that Salaman's Aya papa is not the Aya papa of Ecuador but a hybrid between *S. demissum* ($2n = 72$) and *S. tuberosum* ($2n = 48$).

Inheritance of reaction to common scab (*Actinomyces scabies*) was reported by Krantz and Eide (13). They assumed that the type of inheritance in the potato is autotetrasomic and that the difference observed in reaction to common scab is principally due to the influence of one gene. The segregation obtained from the F_1, F_2, and F_3 generations of a cross between accession 123 and Lookout Mountain approaches the expectancy on the hypothesis that accession 123 is triplex and Lookout Mountain is simplex for the gene Sc influencing reaction to scab. Five breeding groups were found corresponding to the five genotypes Sc_4, $Sc_3\ sc$, $Sc_2\ sc_2$, $Sc\ sc_3$, and sc_4. One hundred eighteen

varieties and selections of heterogeneous origin were classified from sexual progeny tests into five groups corresponding to the above breeding types as follows:

Type 1. The variety Hindenburg.

Type 2. Seven selections and the variety Jubel.

Type 3. Forty-two selections.

Type 4. Thirty-one selections and the variety Earlaine.

Type 5. Thirty-four selections and the varieties Chippewa, Early Ohio, Triumph, and Warba.

Hindenburg gave a progeny from which two segregates were isolated whose sexual progeny gave a significantly higher mean scab reaction than the progeny of Hindenburg. An association between the color factor P and the degree of scab reaction was observed in 13 crosses. The mean scab reaction indexes of P and of p plants for these crosses were 2.49 and 1.99, respectively.

Jensen and Goss (11) showed that potato seedlings about 1 to 2 inches tall can be tested for resistance to *Fusarium solani* var. *eumartii* by transplanting them into infected soil. Six crosses were tested by this means and second- and third-year tests were made on the surviving clones. The second-year tests showed that some susceptible seedlings escaped the first year. In the third-year test 12 clones, comprising 53 plants, produced 221 tubers. Only one of these plants showed symptoms of wilt. The check units of Triumph and Irish Cobbler averaged about 20 per cent infection.

Resistance to Insect Attacks

Sleesman and Stevenson (27) reported that a number of progenies segregated for various degrees of resistance and of tolerance to the potato leaf hopper. Of the 14 progenies tested three showed a small but significant positive correlation, and one showed a negative correlation between resistance to late blight and resistance to hopperburn. Nymphal populations were significantly larger on some seedling varieties than on others. The correlations between nymphal populations and the degree of hopperburn with one exception were not significant. This indicates that the variations between seedlings as to the amount of hopperburn were not because of differences in leaf-hopper populations. Sebago, Sequoia, Katahdin, Rural, and 61 numbered seedlings were significantly more resistant to leaf-hopper injury than Irish Cobbler, Warba, Red Warba, Triumph, Earlaine, and Pontiac.

Schwartz (26) reported that a collection of 700 F_1 and backcross

generation hybrids of *Solanum demissum* x *S. tuberosum* from Berlin-Dahlem and 829 hybrids (some of them triple hybrids), involving as parents *S. acaule, S. chacoense, S. andigenum,* and *S. demissum* from the Erwin Bauer Institute, Muncheberg, were tested for resistance to Colorado beetle attack in Ahun (Creuse). In addition, 75 hybrid clones which had shown promise the preceding year were retested and 16 wild species and 16 approved German varieties were studied with a view to selecting wild and cultivated parents for crossing.

Laboratory tests of resistance to damage were carried out in which freshly emerged larvae were put on cut leaves under controlled humidity. Although there were great variations in the results of these tests in comparison with the field damage, over a large range of material there was striking agreement between the two.

With regard (presumably) to the *Solanum demissum* x *tuberosum* hybrids, there was extreme variation in beetle resistance within F_1 families, whereas there were no marked differences between F_1 families. In the F_2 or in the later backcross generations the resistance of *demissum* was much diminished or even lost. Resistance of the type found in *demissum* x *tuberosum* hybrids was not found in hybrids involving wild species other than *S. demissum*. In the cases where such hybrids survived a strong field attack or artificial infection, their success appears to be due to morphological features or to favorable regeneration and growth characteristics.

Trouvelot (30) reported that planned crosses were started in 1938 at Ahun. Among the new plants none so interesting as *Solanum demissum* was found, but attention has been paid to hybrids of *S. chacoense.*

In the field, resistant hybrids are neither preferred nor especially disliked by the Colorado beetle. Among the hybrids as resistant as *S. demissum* was one giving about one-half the tuber yield of the *S. tuberosum* control. After feeding on *S. demissum* for several weeks the insects are unable to lay eggs even if transferred to *S. tuberosum*. Spectrographic examination of juice-impregnated papers shows a band of fluorescence peculiar to *S. demissum* and its hybrids. There is evidence that the resistance of *S. demissum* is due to a substance developed in connection with chlorophyll activity.

Ecological, Cytological, and Genetic Behavior of Solanum Species and Species Hybrids

Bukasov in Russia (4) gave a geographical and ecological classification of the wild and cultivated South American species of potatoes

collected by the Soviet expeditions. The wild species were divided into 11 groups, and the cultivated Andean species into seven. The climatic conditions of the regions in which the different groups occur were given. The most frost-resistant group, represented by *Solanum juzepczukii* found in the high Bolivian and South Peruvian zone. The less frost-resistant, such as *S. ajanhuiri* and *S. curtilobum*, are grown in a lower zone.

Propach (21) crossed the following diploid ($2n = 24$) species of potatoes: *Solanum verrucosum* Schlechtd., *S. vavilovii* Juz. and Buk., *S. polyadenium* Greenm., *S. jamesii* Torr., *S. chacoense* Bitt., *S. henryi* Buk. and Lechn. and a yet undescribed wild Argentine species which is known by its local name of "papa chusa." Cool, moist weather was most favorable for successful pollination.

1 and 2. *S. verrucosum* ♀ x *S. chacoense* "Bukasov" and "Agraciada" ♂. The F_1 hybrid had the luxuriant growth of *S. chacoense* and was self-sterile but gave a fairly good set when pollinated by other F_1 plants. No disturbances were observed in the pollen mother cells of the first metaphase.

3. *S. verrucosum* ♀ x *S.* sp. "papa chusa" ♂. The growth of the wild species was upright and moderately strong. The leaves were very hairy and of a light grey-green color. It was self-sterile. The F_1 was intermediate, and no abnormalities were observed in the pollen mother cells during meiosis.

4. *S. polyadenium* ♀ x *S. jamesii* ♂. The F_1 most closely resembles the maternal species. In 50 pollen mother cells only two univalents were seen but no F_2 could be obtained.

5. *S. chacoense* "Paraguay" ♀ x *S.* sp. "papa chusa" ♂ and reciprocal. The F_1 hybrid was the same in both direct and reciprocal crosses and most nearly resembled *S. chacoense*. No disturbances were observed at meiosis, and the fertility was good.

6. *S. henryi* ♀ x *S. verrucosum* ♂. The F_1 was intermediate and meiosis was regular.

7. *S. henryi* ♀ x *S. vavilovii* ♂. The F_1 was weakly and though meiosis was normal no F_2 could be obtained.

8. *S. henryi* ♀ x *S. chacoense* "La Pampa" ♂. The F_1 plants were so weakly they died before flowering.

9. *S. henryi* ♀ x *S.* sp. "papa chusa" ♂. The results were the same as the foregoing. From these results it must be concluded that the species genoms concerned must be momologous. Some data are also given on the inheritance of flower colour which suggests, among other things, that there are two different factors for white flower colour.

Perlova (19) found that two triploid (2n = 36) species of potatoes *Solanum tenuifilamentum*, *S. mamilliferum*, and one diploid (2n = 24) species *S. cuencanum*, were self-sterile when grown in low land conditions at Leningrad but fertile when grown in the Pamirs at an elevation of about 7,600 feet. Berry production in the Pamirs took place late in the autumn. The chromosome numbers of seedlings from the three species were found to be 2n = 48-50. Many of the seedlings were fertile. Segregations in the progenies support Bukasov's hypothesis as to the hybrid origin of the triploid species in the group *Andigena* from crosses between *S. andigenum* and diploid species, such as *S. stenotomum*.

Perlova (20) reported that the triploid (2n = 36) potato *S. maglia*, which is sterile at Leningrad, set seed in the Pamirs at an elevation of about 7,600 feet. Three seedlings grown from the seed obtained were similar morphologically to the triploid parent but had a chromosome number 2n = 25 or 26. The majority of the quantative characters were smaller in the diploids than those of *S. maglia*. It was suggested that the seeds were produced by parthenogenesis.

Ivanov (9) reported that the chromosome numbers of seedlings from the backcross F_1 (*Solanum antipoviczii* x *tuberosum*) x *tuberosum* were found to range from 2n = 56 to 2n = 65, the commonest number being 60-61. Seedlings from the backcross F_2 (*S. antipoviczii* x *tuberosum*) x *tuberosum* had somatic numbers varying from 48 to 65, the majority of seedlings having from 58 to 61 chromosomes. Seedlings from the double backcross F_1 [(*S. antipoviczii* x *tuberosum*) x *tuberosum*] x *tuberosum* had chromosome numbers varying from 2n = 48 to 2n = 59, the majority of plants having a somatic number between 50 and 53. Lagging and dividing univalents were observed at meiosis in these hybrids. Forms which might be of use to the breeder were found only among the plants with the lower chromosome numbers (*i.e.*, approaching 2n = 48). In crosses between *S. demissum* and *S. tuberosum* it has also been found that the *Phytophthora*-resistant forms which have been selected for domestic characters have a chromosome number of 2n = 48.

Lamm (14) showed that the cross pentaploid *Solanum curtilobum* female x tetraploid *S. tuberosum* can be easily made and fertile hybrids with chromosome numbers intermediate between those of the two parents are obtained. The reciprocal cross is difficult to make, but it has been carried out by grafting the female parent *S. tuberosum* on tomato. The hybrids produced also have intermediate chromosome numbers, but they are totally sterile. Meiosis in the hybrids with *S.*

curtilobum as female parent takes place normally and in a manner similar to that found in the parents. In the hybrids with *S. tuberosum* as female parent only univalents occur at metaphase and dyads are formed. The nuclei of the dyads generally degenerate. These differences between reciprocal hybrids may be due either to cytoplasmic inheritance or to maternal effects.

Ivanovskaya (10) in Russia reported that studies were made of hybrids of *Solanum tuberosum* ($2n = 48$) with the diploid species *S. rybinii*, of interest for its partial virus resistance, and with *S. phureja*, whose tubers contain up to 19.56 per cent protein. *S. rybinii* is also without dormancy, which is of interest in breeding early forms, and it produces a large number of tubers, which may be a factor in breeding for yield. Chromosome numbers are given for 30 F_1 plants from 19 different combinations, for two F_2 plants, and for one triple hybrid (Epicure x *S. rybinii*) x Furstenkrone. Only 7 of the F_1 plants had the expected 36 somatic chromosomes, 22 had $2n = 48$, and one had $2n = 24$. The F_2 plants *S. phureja* x Centifolia and also the triple hybrid had $2n = 48$. These figures were in certain cases only approximate, the actual chromosome number being in some hybrids 37, and in some 49 or even 50, owing evidently to slight discrepancies in the gametes.

Ratera (22) studied pollen viability in a number of species and varieties of potatoes. The pollen was stained with Lugol solution or acetocarmine; the germination of the pollen in a sugar agar solution was also determined. The results are reported for the following species: *Solanum laplaticum, S. parodii, S. horovitzii, S. gibberulosum, S. garciae, S. chacoense*, and various forms of *S. tuberosum*.

The wild species, with the exception of *S. laplaticum*, had a high percentage of fertile pollen,—domestic varieties a low percentage. Three domestic varieties, Katahdin, Hungara (Hungarian), and Alma had abundant pollen. No germination at all was obtained in the pollen of Green Mountain and Norte-americana (North American).

Bukasov (5) reported that a new species *S.* (*Tuberarium*) *mechonguense* Buk. n.sp., identified at Leningrad, was received from Roberto Millan, who discovered it in the Argentine growing as a "wild potato" commonly found among *Colletia cruciata* in the Province of Buenos Aires. Its chromosome number is $2n = 24$ and it resembles *S. henryi* Buk. and Lechn., though differing from it in certain features of the flower and foliage.

Sterility in the Cultivated Potato, *Solanum tuberosum*

Arnason (1) in Canada studied sterility in cultivated varieties of

potatoes. Bud abscission, length of flowering period, percentage of good pollen, meiosis, and seed production were investigated in the three pollen-sterile potato varieties. United States Department of Agriculture seedling No. 46000 (Mohawk), U. S. D. A. No. 44488 (Sebago), and Early Ohio, and in the five highly pollen-fertile varieties, U. S. D. A. selections No. 46422 and No. 45075 (Earlaine) and Minnesota selections 11-1-2-1, 82-11, and 75-5. Early Ohio and Mohawk produced no pollen in the four years 1937-'40, but Sebago formed a very small amount in three of these years. The five pollen-fertile varieties produced varying percentages of good pollen, the percentage varying with the year and also at different times in the same season. The soundness of pollen of four of these varieties was also proved by successful crosses. The first meiotic division was fairly regular in both types. The pollen-fertile varieties also had a regular second meiotic division, but meiosis in the pollen-sterile varieties began to deviate from the normal development at the end of the first division. In Sebago the two nuclei formed at the end of first division often fuse again at second metaphase. Irregular spindles were also observed. In Mohawk the two nuclei became somewhat pycnotic and shrank in size after first telophase. Second divisions did not usually occur. In the case of Minnesota 82-11 it is suggested that abortion of microspores due to slight structural or physiological defects in parts of the anthers produced the 50 per cent of bad pollen observed. All three of the pollen-sterile lines were capable of forming seeds when pollinated with good pollen. The pollen fertility of ten seedlings from the cross Mohawk x Minnesota 11-1-2-1 was investigated. Only three of these failed to produce pollen, and another three produced abundant pollen.

Colchicine Experiments

Stelzner (28) showed that doubling of the chromosome number of the potato by colchicine treatment of the seeds is relatively easy, immersion in 0.1 to 0.4 per cent solutions for 4 days giving the best results; injury to the roots is reduced by using germinated seeds.

For breeding purposes, however, it was considered that doubling the chromosomes of commercial varieties was likely to give more promising results and this was achieved by the following procedure. Tubers were sprouted in the dark and all but the strongest sprout removed. The roots and tubers were wrapped in paper, and the sprout was immersed for one-third of its length in 0.6 to 0.8 per cent colchicine solution in a desiccator. The air in the desiccator was exhausted for 5

minutes and then the pressure was allowed to return slowly to normal, thus infiltrating the growing point with colchicine solution. The tubers were then planted out and all shoots other than the main one were suppressed. Cuttings were taken from promising plants for the production of tubers. In this way four octoploid ($2n = 96$) strains were produced, one from Konsuragis (No. 1) and three from Pepo (Nos. 2, 3, and 4). Others have since been produced from other varieties.

These strains were grown from tubers in pots in the open and in an experiment to compare them with their parent tetraploid varieties. At first no differences were evident, but later strains 2 and 3 fell about a month behind the tetraploid controls, while 1 and 4 grew as rapidly as the controls. The octoploids produced fewer shoots, usually having only one, with a strong tendency to produce short side shoots. The leaves and leaflets were shorter, thicker, and less regular in form. The flower stalks, also were shorter and more compressed, with thicker buds than in the controls. The broad and compressed anther cone was very conspicuous. Strains 2 and 3 showed the most irregularity in their development, strain 1 showed less, and strain 4 relatively little. The octoploids had shorter stolons, but their tubers were about the same. Our yields were quite variable; on the average octoploid Pepo yielded about one-half as much as the tetraploid,—the average weight per tuber and starch content being about the same.

The areas of the epidermal cells, of palisade cells in sections of the leaflets, and of parenchyma cells in sections of the tuber were compared in the octoploids and the tetraploids. For epidermal cells the ratio tetraploid: octoploid was 1:1.4, for palisade cells 1:2.4, and for parenchyma 1:1.4. Though the pollen grains of octoploids were somewhat larger the distinction was of little use for the detection of polyploidy owing to the large proportion of aborted grains.

The fertility of the octoploids was very low; only four seeds were obtained from 46 pollinations.

Rybin (23) reported that from 100 seeds of *Solanum rybinii* germinated in 0.4 per cent colchicine solution for 6 days there were obtained 13 points, of which five had dark green colour, large cells in the leaves, broad and deep leaf lobes, and large, non-uniform pollen grains. Two plants of this group were examined cytologically and found to have 24 bivalents, whereas a normal colchicine-treated plant had 12, the characteristic number for *S. rybinii*.

Rybin was unsuccessful in attempting to induce chromosome doubling by immersing tuber sprouts in colchicine, as they were killed by immersion either in colchicine solution or in water. The seeds for the

above experiment were obtained from exceptional berries set on normal shoots developed from a tuber, the other shoots of which had been subjected to immersion in colchicine solution and had died. The clone of *S. rybinii* used does not normally set seed. Some of the diploid seedlings, however, were quite fertile, and one of the tetraploids also formed berries, though not early enough to ripen seeds before being killed by frost.

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THE EFFECT OF MOISTURE AND OTHER FACTORS ON POTATO SCAB†

G. H. STARR[1], J. F. CYKLER[2], AND T. J. DUNNEWALD[3]

Wyoming Agricultural Experiment Station, Laramie, Wyo.

Potato scab caused by *Actinomyces scabies* Thax, (Guss), is an im-

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[1]Plant Pathologist.
[2]Agricultural Engineer.
[3]Agronomist, (Soils).

portant disease in many parts of Wyoming. Under certain conditions it is not uncommon to see tubers entirely covered with scab; in fact, the pustules may be so thick that the eyes and sprouts are abnormal. From observation over a period of years, it has been noted that most scab is found at the end of irrigation rows where the water tends to back up and saturate the soil. Likewise, in dry-land fields the most scab is found in the lower portions where moisture is most abundant. Because of the development of irrigation projects and irrigation by pumping from wells, the proportion of irrigated potatoes to dry-land potatoes has increased in the past few years. This fact may have some influence on the future scab problem in the state.

Historical

The literature on potato scab is voluminous and some of it is contradictory, especially literature dealing with factors which favor its development. Numerous workers have found that scab was favored by dry soil conditions (8, 14, 17, 20, 21); others have reported that the moisture factor was a variable one (11, 12) and still others have stated that scab was favored by moisture (3, 13). Investigators have reported for a half century that lime and alkaline soil conditions induced the formation of scab, or that acid soils reduced it (1, 2, 5, 6, 7, 9, 10, 13, 14, 15, 16, 18, 19, 25, 26, 27, 28, 29, 30). Blodgett and Howe (4) reported the least scab from pH 4.3 to 5.4; more scab from pH 7.5 to 8.5; and most severe scab from pH 5.45 to 7.4. Recently Schroeder and Albrecht (22) reported that a liberal calcium supply is not necessarily scab-provoking.

Experimental Methods

This experiment was undertaken in 1942 by John F. Cykler,* Agricultural Engineer, primarily (1) to determine the amount of water necessary for good potato production, and (2) to determine the proper intervals that water should be applied, as shown by soil-sampling methods. Scab prevalence as influenced by moisture and other factors was a co-operative portion of the study the findings of which are reported in this paper. Although the results are based on one year's work, it was felt that a preliminary report should be made at this time as this experiment can not be continued the coming season.

The irrigated plots included in this experiment consisted of a

*On leave in the War Service.

surface 6-inch horizon of light brown loam to fine sandy loam overlying a yellowish to grayish light brown loam to clay loam subsoil. From

FIGURE 1.—Showing a small cross-section of the irrigation plots and J. F. Cykler taking samples in the early summer

12 to 16 inches in the lower part of the "B" horizon occurs a concentration of lime carbonate associated with small amounts of gravel or scattered cobble stones. The soil is fairly well drained, absorbs water quite readily and its reaction is generally basic with a range of 7-8 in pH. The soil is somewhat low in organic matter and responds to manure and nitrogen. Small responses to phosphorus also are obtained. When the soil dries out after irrigation, slight indications of salts are seen on clods or lumps, but the concentration generally remains below the level where toxic effects on plant growth occur (0.25 per cent).

This plot of ground had been in alfalfa for the past seven years.

Previous to planting, it was crowned in the fall, plowed deep in the spring and worked down well in the usual manner.

The four following methods of irrigation were used: (1) "General practice," (receiving 5 irrigations at intervals of from 6 to 20 days, or a total of 45 inches of net irrigation water), (2) "Minimum soil moisture variation," (receiving 9 irrigations at intervals of from 3 to 8 days or a total of 60.7 inches of net irrigation water), (3) "Medium soil moisture variation," (receiving 8 irrigations at intervals of from 4 to 12 days or a total of 47 inches of net irrigation water and (4) "Wide soil moisture variation," (receiving 4 irrigations at intervals of from 12 to 18 days or a total of 11.5 inches of net irrigation water).

Each irrigation plot consisted of 8 rows,—each 40 feet in length. The rows were three feet apart with the potatoes planted at 12-inch intervals. Each irrigation treatment was replicated four times in a randomized manner. All irrigation water was measured as it flowed on the plots by means of weirs. The excess water leaving the plots was likewise measured in this manner. The irrigations were not made at a prearranged interval nor was a definite amount of water applied. The plant condition or plant "climate" dictated the water use of the plants. Before each application of irrigation water, soil samples were taken to determine the soil moisture content in each irrigation series. The average minimum soil moisture during the season from 0-12 inches, 12-24 inches and 24-36-inch levels in the four types of irrigation plots is shown in table 1.

TABLE 1—*Average minimum soil moisture during the season in the A, B and C soil horizons of the four types of plots.*

Type of Irrigation	Average Minimum Soil Moistures		
	A 0-12" Per cent	B 12-24" Per cent	C 24-36" Per cent
General Practice	13.7	16.8	17.3
Minimum Variation	16.5	10.2	19.0
Medium Variation	15.7	18.2	17.4
Wide Variation	13.2	17.9	17.4

The dates of irrigation on the various plots, are as follows:
General Practice—July 14, August 4, 16, 27, and September 2.
Minimum Variation—July 14, 20, 27, 30, August 6, 11, 19, 26 and September 1.
Medium Variation—July 14, 22, 26, August 7, 12, 19, 28 and September 1.
Wide variation—July 14, August 1, 13, and 29.

The plots were hand-planted on the 20th of May with the Bliss Triumph variety. On the 25th of September the two center rows of each plot were harvested separately and later carefully inspected for the prevalence of scab. The scab pustules were almost entirely of the common type. The tubers were classified into the three following groups: (1) slight scab (tubers having from a trace to 20 per cent of the surface covered with scab); (2) medium scab, (tubers having from 20 to 40 per cent of the surface covered with scab); and (3) heavy scab, (tubers having over 40 per cent of the surface covered with scab). The potatoes in each scab-group were weighed and the percentages were calculated for each row harvested.

In order to compare the total scab more accurately in one lot with that of another, a scab index figure was calculated for each lot of potatoes. This was done by multiplying the percentage of slight scab by 1; medium scab by 2 and heavy scab by 3, the summation giving the index number. This method was used previously by Starr (24). In most cases the two center rows were in close agreement in scab prevalence and in some cases the index figures were identical. These figures for the two center rows were averaged and are shown in table 2.

TABLE 2—*Percentage of tubers (by weight) having slight, medium and heavy scab in the four irrigation series, together with the calculated index number.*

Type of Irrigation	Slight Scab	Medium Scab	Heavy Scab	Index Number
1. General practice	7	84	9	202
2. Minimum soil moisture variation	3	58	38	235
3. Medium soil moisture variation	4	68	28	224
4. Wide soil moisture variation	9	79	12	203

In order to study various soil factors that might influence scab development, composite soil samples were taken to a depth of six inches from each replication of the irrigation plots after the potatoes were harvested. Laboratory tests were made for soluble salt content, soil pH, calcium carbonate content and available potassium and phosphorus, in the following manner. The soil reaction test was made colorimetrically and later checked with the glass electrode. The lime content was calcu-

TABLE 3—*Results of the soil tests made in the laboratory, together with the scab index and potato yields.*

Irrigation Treatments	Net Irrigation Water Applied (In inches)	Soluble Salts (Per cent)	Soil pH	Lime Content (Per cent)	Available Phosphorus (Lbs. per Acre)	Available Potassium (Lbs. per Acre)	Scab Index	Total Yield (Bushels per Acre)
1. General practice	45.0	.046	7.42	0.86	5.7	48.7	202	332
2. Minimum soil moisture variation	60.7	.035	7.40	1.02	5.7	38.7	235	325
3. Medium soil moisture variation	47.0	.037	7.35	0.42	5.2	41.2	224	321
4. Wide soil moisture variation	11.5	.039	7.65	0.54	5.0	56.2	203	278
Difference necessary for significance 5 per cent point		.022	0.58	1.04	1.5	30.8	15	47

lated from the evolution of CO_2 (carbon dioxide) with dilute acid from a gram sample of the soil. The available phosphorus and potassium were determined by the Spurway Method (23). Our results are recorded in terms of pounds per acre,—six inches deep. All of these data were analyzed by the Variance Method. The results of the soil tests, together with yields and scab prevalence, are shown in table 3.

Table 3 shows that the only significant differences between the irrigation plots are those of scab prevalence and yield. Because of considerable variation in some of the factors listed above, it was thought advisable to calculate correlations between scab and these factors in order to determine possible relationships. The results were as follows: Lime content and scab, $r = .171$; pH and scab, $r = .252$; soluble salt content and scab, $r = -.123$; available phosphorus and scab, $r = -.183$ and available potassium and scab, $r = -.128$. None of the above correlations reached the level for significance ($r = .482$).

Discussion and Conclusions

An important cause of soil variability was the depth down to the concentration of lime in the subsoil. In a few plots the lime was found as close as eleven inches from the surface and in the operations of leveling, ditching and irrigating some of the subsoil lime materials had been mixed with the surface soil. This is especially true of three of the plots where the lime content was high (1.02 — 2.99 per cent).

The "Minimum variation" plots, or those receiving the largest quantities of irrigation water, produced the most scab. This is in agreement with common observations made both under irrigated and dry-land farming areas in Wyoming. Thus, excessive irrigation water should be avoided as scab may be increased, though yields may not be. The reduction of irrigation water to a point where yields are significantly reduced, as in the "Wide variation" plots, gave no decrease in scab when compared with the "General practice" plots.

The percentages of soluble salts were variable in the different replications and apparently had no relationship with scab prevalence.

The soil pH, although highest in the drier irrigation plots, was not of sufficient range to expect differences in the prevalence of scab.

Although it is generally thought that soil applications of lime favor scab, the lime carbonate content of these plots was not found to be a significant factor. The lime carbonate varied from 0.26 to 2.99 per cent in the various plots and while scab was most prevalent in the plot with the highest lime content, this relation was not consistent.

The available potassium content varied from 20 to 80 pounds per acre in the various plots, but this amount of variation did not significantly influence scab prevalence.

The highest yield was obtained in the "General practice" plots, followed closely by the "Minimum" and the "Medium variation" plots. The first two were significantly higher, whereas the third was nearly significantly higher in yield than the "Wide soil moisture variation" plots.

Summary

Potato scab is an important disease in many parts of Wyoming and its prevalence is often thought to be affected by irrigation practices.

In the field irrigation experiment reported herein, most scab was found in those plots receiving the most irrigation water. There was no significant relationship found with scab prevalence and the following factors studied: soluble salts, soil pH, lime content, available phosphorus or potassium.

The yields of potatoes were highest in the plots where "General practice" methods were used, followed closely by "Minimum variation" and "Medium variation," although these differences are not significant. The yield of the "Wide variation" plot was significantly below the "General practice" and "Minimum soil moisture variation" plot.

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SECTIONAL NOTES

CALIFORNIA

Approximately fifteen per cent of the potatoes produced in the Klamath Falls District and which were still in the ground at the time of the recent freeze will be considerably damaged.

It is difficult to say what the actual loss will be but—to handle potatoes which were field-frozen is a very hazardous,—and foolish business.

In Idaho, Pocatello north had approximately 2,500 cars in the ground and Burley to Buhl, approximately 5 to 6,000 cars at the time of this cold spell.

One of our correspondents says, "Some people are kidding themselves and think the damage to these potatoes is slight, but I want no part of them, as I would rather have the other fellow handle them."

Prices on No. 1 potatoes in both the Klamath Falls District and Idaho are at the ceiling No. 2's have been gradually advancing and are bringing considerably higher prices now than they did three weeks ago.

We have one report from Idaho to the effect that "In spite of the record crop, it looks as if we won't have enough left to take care of the normal requirements of the regular trade." This is estimated on 5,000 cars already lost from frost damage with the possibility of losing at least 10,000. Further, that the Armed Services will use between 4 and 5,000 cars and the Dehydrators will probably take almost 10,000, so from an estimated crop of 45,000 heavy cars, there will not be even normal yearly supplies left.

The Trade are complaining about the fact that no premium has been allotted by OPA for Baker Potatoes—10 ounces and up. (Nov. 8)—E. MARX.

* * * *

The Irish potato is primarily in the period of inactivity. At the present time there are possibly somewhere from 100 to 1,000 acres of what we call Fall potatoes that will be harvested and sold as new potatoes.

Most of the growers at present are devoting their time to the preparation of soil, the purchasing and storing of seed, as well as purchasing fertilizer for the 1944 crop. It is impossible at the present time to tell what the 1944 potato acreage will be. Furthermore, the amount and kind of fertilizer, as well as the amount and quality of seed, may have considerable bearing on the 1944 acreage.

Generally speaking, the feeling among the growers at the present

time is that a greater acreage will be planted in 1944 than was planted in 1943. (Nov. 4)—M. A. Lindsay.

IDAHO

The important problem in Idaho today is how much damage did the late October-early November freeze do to undug potatoes. As would be expected, the estimates run from very little damage to a loss of 10,000 to 12,000 cars. No one will know until harvesting has been completed and the potatoes have been in storage for some time. There was probably approximately twenty per cent of the crop remaining in the ground when the freeze occurred on the 30th of October. Every one, however, seems to agree that there is some loss. A conservative estimate in the writer's opinion is less than five per cent of the total Idaho crop.

Our potatoes are continuing to move readily and dealers' purchases from growers reflect ceiling or near ceiling prices. Nine hundred ninety-one cars were moved from the 4th to the 10th of November inclusive, which included four for manufacture (probably shipped to coal dehydrating plants). On the 10th of November Idaho had shipped 2,535 cars more than those shipped by the same date in 1942. About 1,000 of these cars were from the late districts, the other 1,500 reflecting increases in acreage in the early districts. The 12,332 cars shipped by this date should be approximately one-third of Idaho's shipments if dehydrators work to capacity.

No serious storage problem has arisen, and old and newly-built storage will apparently take care of the crop.

One new dehydrator began operating this past week. Idaho now has seven dehydrating plants, three starch plants and a potato flour mill. Most of the certified seed have been harvested and are in storage. The yield is smaller than that of last year. Our growers are anxiously awaiting the announcement of price ceilings by OPA. Some growers have contracted their seed at the ceiling. (Nov. 13)—Eugene W. Whitman.

INDIANA

There just isn't much of a potato problem in Indiana at the present time. Our crop was short and was used at home. Our people have taken advantage of the potato week program and have bought potatoes to supply their needs. The retail price has been reasonable and the quality of potatoes,—fair to good. We will need several sacks of certified seed next year, particularly of Irish Cobbler and Katahdin, as well

as some other odds and ends. We want this seed to be good. (Nov. 11)—W. B. WARD.

KENTUCKY

Summarized in one sentence,—"The finest second crop in more than ten years." Our acreage increase ranges from 9 to 1, or about 135 bushels per acre. In the order of their yield: Irish Cobbler, Katahdin, Chippewa, Warba, the complaint is rather general that "chip" and Warba stands were below average, but individual hills of Warba exceeded all others. Sequoia was quite generally tested, but was still immature,—having been planted the 25th of July at Cobbler time, which is too late.

As a whole, the quality is fine; the skins are bright and there is almost no scab. (Nov. 12)—J. B. GARDNER.

MAINE

Some potatoes still remain in the ground, but in all probability our harvesting is over with and those remaining now will freeze. Maine has had a most unusual season. Our lowest temperature to date occurred on the 10th and 11th of October, though we have had some closely approaching that since. Since the middle of October it has been raining or snowing most of the time and growers have found it very difficult, if not impossible, to make much progress with harvesting or with their usual fall work. Maine has dug its biggest crop on record, both in acreage and yield. This, together with a late maturity, has made it very difficult all the fall. Splendid cooperation has been given by public agencies; The Extension Service, The War Food Administration, Commodity Credit Cooperation, Food Distribution Administration and others. Every one has turned to without thought for self or of advantage to their particular group in order to help. There have been disappointments and delays and many uncertainties, but through it all we have accomplished much more than we ever thought possible.

The seed shipments have started. There seems to be more trouble from grading out the oversize than any other one factor. This crop is a large sized one, and to get a grade that meets specifications will require a great deal of close attention on the part of all concerned. Very little net necrosis is showing up, nor is there any stem end browning. There has been considerable difficulty with frozen ends in Katahdins and Sebagoes, but as the crop remains in storage this trouble can be more easily detected and kept at home. Announcement has just been made here today on ceiling prices for seed, permitting $1.00 per cwt over the

base price on tablestock for the various months. This clarifies sales procedures materially. Cobblers, Chippewas and Green Mountains are now selling at ceiling prices and we expect them to continue for the rest of the season. It appears without question that Maine will be enjoying a very heavy demand for both seed and tablestock all the season, and particularly will this be true in seed. By spring it will again be a question of finding available supplies rather than the factor of price.

Maine mourns as does other states the passing of Mr. Fred Bateman. He justifies as does few men a permanent place in the Hall of Fame of the potato world. (Nov. 18).—F. W. HUSSEY.

MICHIGAN

Our harvesting operations were completed during the last week of October with the most ideal weather conditions we can ever remember. Some growers even complained that the ground was so dry they had trouble to get enough dirt over the digger to keep the tubers from being injured.

The quality of the Certified Seed crop is exceptionally good. The tubers are generally small, which makes them ideal for seed purposes. The crop is about twenty per cent above that of a year ago. This increase was mostly brought about by increased acreage. Considerable interest in seed is being received with inquiries being greater to date than at any time in the past. Few sales have actually been made. Our growers are holding off until the OPA seed order is released.

Bin inspection on Certified Seed is about completed. Michigan will have a limited supply of the War Approved Seed. A field inspection was made on War Approved Seed late in the growing season. (Nov. 9).—H. A. REILEY.

MINNESOTA

Minnesota potato growers, in general, enjoyed one of the best production seasons in many years. The sand land area potatoes were planted without the delays suffered in the Red River Valley and in the Hollandale sections. In the Red River Valley, planting started, as usual early in May, but had just gotten nicely started when intermittent rains, extending past the middle of June, interferred to such an extent with planting operations that planting was not completed until July. The heavy rains in the southern end of the Valley drowned out about fifty per cent of the acreage which was finally planted. At Hollandale, where approximately 6,500 acres were planted, extremely heavy

rains early in the growing season destroyed at least one-half of the acreage.

After the first week in July, the entire northern half of the state had excellent growing weather up through harvest. Late blight, which occurred in epidemic form in 1942, appeared later this year, here and there, but the loss suffered because of this disease was not particularly serious except in a few isolated cases. Growers had been warned early in the spring to be prepared to control the disease if it should occur. Very few new high pressure sprayers or high power dusters were available to Minnesota growers and many of the larger growers had their fields dusted by airplanes. Three such machines were kept busy in the Valley during the latter half of the growing season.

Our harvesting operations were completed under ideal conditions and the crop was all under cover before any low temperatures prevailed. The increased acreage planted, together with the good yields of excellent quality potatoes, means that we have a crop of approximately 25 million bushels. To date very few cars have had to be sold at the support price.

Twenty-two thousand, three hundred and forty-eight acres, consisting mainly of Triumphs, Cobblers, Ohios, Warbas (red and white) and Chippewas were entered for certification. Of this acreage, 18,877 acres qualified for certification,—with a production of 3,500,000 bushels of certified stock. To date, certification tags have been issued for more than 300 cars of certified stock.

The problem of harvesting the crop this Fall gave the growers considerable concern, but organized effort among school children and local business men, together with what other labor could be employed took care of the situation remarkably well. (Nov. 4).—A. G. TOLAAS.

NEBRASKA

The harvesting of the Nebraska potato crop was completed by the last week of October, with the exception of a very few growers. These individuals, for one reason or another, are flirting with Dame Nature, and taking a chance that the crop would be frozen in the ground. Excellent harvesting conditions prevailed throughout the month of October, and freezing temperatures which would injure the potatoes in the ground, did not occur until the week of the 25th of October.

The results of the harvest in the western high plains areas, in which Nebraska potatoes are principally grown, were quite disappointing. An extremely early frost on the 8th of September stopped the growth in many of the dry land fields. The irrigated territory of the

North Platte Valley, as a whole, escaped this freeze. The result was that excellent yields that were in prospect on the dry land were reduced by at least fifty per cent. Such yields ranged from 40 to 125 bushels per acre, probably averaging nearly 60 bushels per acre. In the case of the irrigated growers, their yields ran in the neighborhood of 300 to 350 bushels per acre for the best, with an occasional yield exceeding 400 bushels. A good many irrigated yields, however, dropped to the neighborhood of 200 bushels, because of adverse conditions, such as rather poor stands, frost in a few areas, and other factors.

The cellar inspections on Certified potatoes and War Approved stocks got under way about the 10th of October. By this time, (Nov. 4) such inspection has progressed to the point where it is safe to predict that the major portion of the crop will pass inspection in both classes of seed.

The results of the cellar inspection show that the quality is good, but grade-outs may be relatively high on the dry land, because of the poor digging conditions. There had been no rainfall during the latter part of the season, and the soil was dry and extremely cloddy. Under irrigation, however, conditions were favorable for digging operations, and a high percentage of good quality potatoes was dug.

Disease conditions of the crop are good. Stem End Discoloration caused by Fusarium Wilt, usually a serious factor in Nebraska potatoes, is exceptionally low. Flea Beetle injury, that has been increasing in a number of territories, was considerably less this year than during the past season. In some areas, scab is the most serious problem, but as a whole, it, too, is not troublesome.

Sales of Certified potatoes are good, particularly for the dry land crop. It is reported that most of the dry land crop has been contracted for sale at ceiling prices, and a considerable portion of the irrigated crop as well. Sales on War Approved seed potatoes have been slow, but are picking up lately. This is accounted for by the fact that this is a new class of seed potatoes, and the trade is not familiar with it yet. In the case of the War Approved seed potatoes, prices have not reached the ceiling, but are substantially above the table stock. (Nov. 8).—MARX KOEHNKE.

NEW JERSEY

The potato crop in New Jersey is now completely harvested and movement of small amounts of seed is being made. Light shipments of our late varieties of table stock are still being made at about ceiling prices.

Our seed potato yields are somewhat higher than our October estimates,—not only because of favorable growing conditions, but also because of the late killing frosts. The harvesting of some of this seed has been delayed chiefly on account of the wetness of the ground caused by recent rains.

Many cars of Maine potatoes have been shipped to dealers in the state, in bulk, in order to eliminate the labor shortage there. Many of these cars have contained a few frosted potatoes, but the dealers have been able, in most cases, to make a fair pack from the supplies received, and have aided greatly in getting the huge crop moved out of Maine.

At the present time, many of our growers are thinking of next year's crop and are planning to plant, at the least, as many potatoes as they did during 1943. They are now getting and storing their supplies of seed, and are also making arrangements for the fertilizer they will need for their work. (Nov. 17).—J. C. CAMPBELL.

NEW YORK

No change in the size of the 1943 potato crop for New York was reported in the forecast of November 1st. Weather conditions were, on the whole, quite favorable for harvest even though October was abnormally wet. Blight rot was prevalent over the state in the smaller fields and those which had not been well sprayed or dusted. It was not at all serious in the well sprayed fields of the big commercial growers. The exceptionally dry weather of September helped to check blight even though it hastened maturity and reduced the potential yield.

Many new storages were completed this fall and so far as known, no serious lack of storage space was felt. Whether the stored crop will store well is a question because much of it was very immature when harvested. Reports concerning the various types of seasonal or transient labor for harvest have been mostly satisfactory. High school children, local women, southern negroes, and Bahamians were the types used. Good wages were made where the prevailing wage rate of about 6 cents per crate or bushel was paid.

On October 14th and 15th at Syracuse, an important goals conference was held under the auspices of the State War Board. Although the proposed potato goal for New York for 1944 was 103 per cent of 1943, the farmer committee there decided that 105 per cent of 1943 or 237,000 acres would be more nearly the feasible goal to aim at. The factors most critical in attaining such a goal were cited as seasonal labor, the continuance of the support price and purchase program, an increase

in the support price to cover increased costs of production, and critical parts for potato machinery. (Nov. 16).—E. V. HARDENBURG.

NORTH CAROLINA

The North Carolina Crop Improvement Association received applications for the certification of 198 acres of Irish potatoes in 1943. Of this number 185 acres were passed and 13 rejected after our field inspection. The acreages rejected by varieties follow: Sequoia, 9; and Green Mountain, 4. The total number of acres passed are, Sequoia, 184; and Green Mountain, 1.

The interest in the production of better seed stock is on the increase and some growers are tuber-indexing. Fred N. Colvard of Jefferson, the largest grower of certified seed in the state, produced all of his 1943 seed from indexed stock.

A series of five meetings will be held in the early belt during the week of the 15th of November. At these meetings, members of the Experiment Station staff will discuss results of the research program with Irish potatoes, and representatives of the Extension Service, State Department of Agriculture and the W. F. A. will review the year 1943 and make recommendations for 1944. (Nov. 8).—M. E. GARDNER.

OREGON

Our harvesting of certified seed potatoes is about complete. The yields are average or better, and the quality is excellent. The harvested certified acreage in this county is approximately 1,200. The commercial potatoes should be completely harvested by the end of this week.

Our harvesting operations were delayed by unseasonable rains and some cool weather. The yields, as a whole, are about average or slightly less. The quality is generally good, and, to date, the shipments are heavy. Practically all storage facilities are taxed.

Since the labor situation is extremely difficult, our harvest season has been prolonged. In general, the harvest season has been very difficult for growers throughout this area. This situation might affect the acreage planted for 1944. (Nov. 2).—C. A. HENDERSON.

PENNSYLVANIA

The potato crop harvested in Pennsylvania (19,500,000) bushels was of fair quality but the tuber size was, in general, below average. In the mountain counties, Russet Rural out-yielded other varieties, whereas farther south Katahdin made a good showing. Sebago stands were poor and the resultant crops often light. Ring-rot was evident

in at least fifty per cent of the crops. The loss from this disease was difficult to determine, since the long dry period of August and September allowed many affected tubers to disappear completely before harvest. A loss to the state of four per cent of the entire crop would be a conservative estimate. Late blight losses were light, one per cent or less. However, a comparison of yields between sprayed and unsprayed potatoes again showed a difference of approximately 100 bushels. Commercial potato spray rings have become an integral part of the potato growing program in the state. Seventy spray rings sprayed for nearly 2,100 growers covering approximately 14,000 acres. At an average increase of 100 bushels per acre for spraying, there were 1,400,000 more potatoes in the state than if this machinery and labor-saving practice had not been instituted. (Nov. 9).—O. D. BURKE.

* * * *

There were more than 2,100 acres of potatoes entered for inspection for seed certification in the state this year. Of this amount there are nearly 1,200 more certified. More than 200 acres, or approximately forty-two per cent of the total acreage entered, was rejected.

The acreage certified this year is the largest ever produced in the state. Pennsylvania will also have a larger crop of certified seed potatoes this year than ever has been produced in any one previous year. In 1934 there were 241,789 bushels certified. This year there will be more than 300,000 bushels of seed compared with 211,350 bushels produced in 1942.

Over two-thirds of the crop was produced on the mountain plateau in the Potter County area, where growing conditions were quite favorable. The planting season in this area was quite late and many fields produced their crops in a period of less than ninety days. Our yields are averaging slightly more than 250 bushels per acre, with some running as high as 400 per acre.

The tubers are slightly larger this year than usual, although the crop is very uniform, free from dirt, scab and other surface blemishes.

The principal varieties certified this year are the Russet Rural, Katahdin, White Rural, Sebago, Chippewa and Houma. (Nov. 8)—K. W. LAUER.

SOUTH DAKOTA

South Dakota potato growers harvested their crop this year under the most ideal weather conditions that they have ever experienced. After a slow start the first of September, the weather cleared up, and our growers worked at the harvest four weeks in succession, six days to

the week without an interruption. All our potatoes were harvested and under cover before any serious frost.

The yields of certified fields were even better than expected and the Bliss Triumphs will average almost 200 bushels per acre. It is now estimated that 900,000 bushels of certified seed were produced in South Dakota this season. All warehouses in this area were filled to the roof and some stock eligible for certification has been sold as table stock because of lack of storage space. About 150 cars of certified seed have been shipped to date and our shipments will be resumed about the 15th of December.

Contracts again are now being made for winter delivery on Bliss Triumph stock. The final report on acreages entered for certification which have passed the field inspection shows that 4534 acres are all eligible for certification. Of this amount, 3275 acres are Bliss Triumphs; 921 acres, Irish Cobblers; 106, Early Ohios; and 232, other varieties. There will be about 500 acres eligible for War Approved seed.

A larger acreage of War Approved seed would have been supported if the regulations had come out sooner. Growers are very optimistic and expect to increase their acreage of certified seed next season. (Nov. 9)—JOHN NOONAN.

VERMONT

Continuous wet weather through August and the first week in September resulted in a very serious late blight epidemic. Seed and commercial growers took advantage of every opportunity to apply spray or dust and, in general, suffered no great amount of tuber rot. In a high percentage of the smaller fields and Victory gardens, however, losses, varying from fifty to eighty per cent of the potatoes were not uncommon. In some cases, digging,—even of two or three acre lots,—was given up.

Though OPA was prepared to carry out the purchase program,—only one sale to that agency had been made at the time of this writing. Loading stations were designated and about ten cars were graded and passed inspection ready to be purchased by the Government, but commercial buyers were found for them at support price.

Apparently all growers were able to find storage for such of their stock as cannot be handled in the fall trade. Local trade appears to have been brisk with prices up to, or higher than, the support figure.

About 625 acres passed field certification out of more than 800 which were entered. This is the largest acreage certified in the state since 1933, and is eighty-five per cent higher than that of the past two years.

The major part of our rejections resulted from finding traces of ring rot in certain lines of seed late in the season. (Nov. 8)—HAROLD L. REILEY.

WASHINGTON

Harvesting of potatoes, both seed and commercial, in Washington is practically completed. Apparently, we have the largest total production of potatoes that we have had in years. Favorable weather conditions during the latter part of the season increased the total tonnage by more than was anticipated. We are finding however that the estimated tonnage of certified seed potatoes is below the actual production, because of the favorable weather following the final inspection of a number of fields.

The estimated production of our principal varieties of certified seed and the total of all varieties follow: Netted Gems, 91,733 bushels, White Rose—149,433, total of all varieties, 248,333 and War Approved seed potatoes—72,800 bushels. All the potatoes of the White Rose variety have been sold, and the majority of them shipped to California.

The total production of all potatoes in the state of Washington for 1943 was 11,660,000 bushels, as compared with a production of 7,800,000 bushels of potatoes in 1942. (Nov. 6)—CHAS. D. GAINES.

CANADA

According to a summary of field inspections recently compiled by J. W. Scannell, District Inspector, Dominion Seed Potato Certification Service, Ontario Agricultural College, Guelph, Ontario, 1,895 acres of potatoes were entered for field inspection in Ontario during the 1943 season. Of this number, 1,331 acres met with standards adopted for certified seed or seventy per cent of the total. This is a slight increase in the number of acres compared with previous years. The total acreage of commercial potatoes for Ontario this year is estimated at 116,000, or a decrease amounting to more than five per cent.

The leading variety is the Katahdin, with 825 acres passed. The Chippewa ranks second, with the Irish Cobbler and Warba as leaders for the early varieties. The Rural New Yorker is on the decrease.

Yields from certified fields are reported as favorable, and the quality in most cases, is excellent. The market has been very active and during recent weeks unusually large quantities of seed from inspected fields have changed hands. (Nov. 8)—R. E. GOODIN.

Erratum:

In the September issue, Vol. 20, No. 9 in Sectional Notes, page 259, paragraph 3 should read as follows:

CALIFORNIA

"Perhaps the solution to the question of surplus on low grades which appears to be quite pressing not only in this particular district, but also in many others, might be found in a general promulgation whereby during the present emergency no potatoes could be put up grading over eighty-five per cent, U. S. No. 1."

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INFLUENCE OF TIME OF PLANTING OF POTATOES IN INDIANA MUCK SOIL ON YIELD AND SCAB DEVELOPMENT[1]

R. W. Samson and N. Kent Ellis

Purdue University, Agricultural Experiment Station, Lafayette, Ind.

A general opinion among growers that planting of potatoes in the muck soils of northern Indiana should be delayed until the 25th of May or later, because of possible late spring frosts, led to some preliminary date-of-planting tests when experimental work on potatoes was initiated by the junior author on the Northern Indiana Muck Soils Experimental Farm, near Walkerton, Indiana, in 1937. The results of these tests indicated that total yields might be increased by much earlier plantings and also that the resulting crops would be less scabby. More detailed tests were made on the Farm in the years from 1939 to 1942, in which both total yields and yields of essentially scab-free tubers were determined for crops from plantings made at 2-week intervals from the 5th of May to the 5th of July. The results of these tests are reported in this paper. They clearly show a distinct advantage of early May plantings, regarding both the total yields and the yields of potatoes sufficiently free from scab to meet U. S. No. 1 standards.

Frost-Free Growing Season on the Muck Farm

The frost-free growing season on the muck soils of northern Indiana is relatively short. The frost-free periods for the years 1937 to 1942,

[1]Journal Paper Number 85, of the Purdue University Agricultural Experiment Station, Lafayette, Indiana. Contribution from the Departments of Botany and Horticulture.

inclusive, ranged from 125 to 142 days, with the latest spring frost recorded on the 17th of May, 1939, and the earliest fall frost on the 13th of September, 1937. Potatoes that were planted the first week in May were in no danger of injury from the latest spring frost recorded. Killing frosts rarely occur later than mid-May in this area. The higher yields obtained over a period of years from the early May plantings of potatoes would more than off-set any possible loss from a rare late frost.

Experimental Methods

Plan of Experiments. The regular date-of-planting tests in 1939 and 1940 consisted of duplicate, 3-row plots of Katahdin, 50 feet long, planted on each of 5 dates, at 14-day intervals as indicated in table 1. Those in 1941 and 1942 were split-plot experiments, planted in Latin Squares. The test in 1941 consisted of 5 replications of Katahdin and Irish Cobbler, planted on each of the 5 dates. Each plot consisted of 2 rows, 50 feet long. The 1942 test consisted of 40-foot, single-row plots of Katahdin, Irish Cobbler and Sebago, replicated 5 times on each planting date. The rows of all plantings were 36 inches apart, with a 12-inch spacing of seed pieces. All plots received a broadcast application of 0-8-24 fertilizer at the rate of 1,000 pounds per acre, well-disced in prior to the first plantings.

Records. At harvest time, the total yield of tubers passing over a 1⅞-inch screen was recorded for each plot. Then, in the case of all except the 1940 test, either the total plot yield of such tubers or a sample of 100 or more tubers from each plot was divided into marketable and unmarketable classes, depending upon whether or not 5 per cent or less or more than 5 per cent, respectively, of the tuber surface, or volume in the case of pitted scab, was involved in scab lesions. In some of the experiments the marketable class was sub-divided into tubers with no scab and those slightly scabby, whereas the unmarketable tubers were divided into moderately and severely scabbed groups. Numerical values of 0, 1, 2, and 3 were assigned to these respective classes of scab severity. A scab index was then calculated by multiplying the number or weight of tubers in each class by the respective class value and dividing the sum of these products by three times the total number or weight of tubers in the sample. This quotient was then multiplied by 100 to give the scab index. This method is similar to that described by Walker, *et al.*, (1) and gave a figure indicative of the total surface scabbed in the sample. Statistical use was thus made of the varying amounts of scab in the major classifications and permitted

TABLE 1—*Influence of time of planting of three potato varieties in Indiana muck soil on total*[1] *and marketable*[2] *yield per acre. Northern Indiana Muck Soils Experimental Farm, Walkerton, Indiana.*

Year	1939		1940	1941				1942						Averages	
Variety	Katahdin		Katahdin	Katahdin		Cobbler		Katahdin		Cobbler		Sebago			
	Total	Market-able	Total	Total	Market-able	Total	Market-able	Total	Market-able	Total	Market-able	Total	Market-able	Total	Market-able
Planting Dates	Bu.	Per Cent	Bu.	Bu.	Per Cent	Bu.	Per Cent	Bu.	Per Cent	Bu.	Per Cent	Bu.	Per Cent	Bu.	Per† Cent
May 5-6	363	97	252	370	26	406	4	356	81	442	73	369	84	365	61
May 19-21	325	97	212	300	13	417	5	331	56	378	45	326	52	327	45
June 2-5	241	90	203	222	17	289	16	287	24	281	31	307	40	261	36
June 16-20	145	89	151	121	5	142	1	269	85	192	28	340*	65*	170	42
June 30-July 5	101	84	99	21	0	16	0	72	64	67	42	157	50	76	40
Least significant difference at 5 per cent level	—	—	—	—	19	—	7	64	24	43	11	44	18	—	—

[1]Total yields included all No. 1 size tubers, or those passing over a 1 7/8-inch screen.
[2]Marketable yields included all No. 1 size tubers with not more than 5 per cent of surface or volume involved in scab lesions.
†Total yields of Katahdin in 1940 were not included in calculating average percentages marketable.
*Sequoia was accidentally planted instead of Sebago on this date. It was excluded in calculating average percentages marketable.

the determination of the significance of smaller differences between treatments than was possible with the two major classes.

Pitted and Surface Types of Scab Involved

Two types of scab were encountered in the experiments. The lesions of one type were mostly large and very corky, frequently extending below the tuber surface leaving severe pits when the corky tissue was removed. This pitted type of scab developed more conspicuously on Irish Cobbler than on Katahdin. The second type was much more superficial,—the lesions appearing as small russetted areas,—sometimes so numerous that they almost covered the entire tuber surface, or as slight protuberances with depressed centers. These lesions were covered with a very limited amount of corky tissue. Both of these types of scab commonly occur on potatoes grown in the muck soils of northern Indiana. The pitted type is more severe in the deeper, somewhat wetter mucks, whereas the superficial type occurs in drier mucks, particularly in the margins of muck soil deposits. These types are referred to as pitted and surface scab.

Total Yields Decreased with Later Planting

The average yields per acre by planting dates, years and varieties are shown in table 1 for the four regular date-of-planting experiments. It may be seen from the table that the total yields consistently decreased with later plantings. Only in the case of Irish Cobbler in 1941 did the yield of the second planting approximate that of the first. The first four plantings of Irish Cobbler out-yielded the corresponding plantings of Katahdin in 1941, while in 1942 the first three outyielded Katahdin. However, the yields of Irish Cobbler dropped more rapidly with delayed planting than did those of Katahdin. The average total yields for the two tests with Irish Cobbler were 424, 397, 285, 167, and 42 bushels per acre for the respective planting dates. The averages for the corresponding two trials with Katahdin were 363, 315, 254, 195, and 46 bushels. The averages for the 4 Katahdin trials were 335, 292, 238, 172, and 73 bushels for the respective planting dates.

The average yields for all varieties and years are shown in the last section of the table. The second to fifth plantings averaged 38, 104, 195, and 289 bushels less, respectively, than the first planting.

The results of the one test with Sebago indicate that its yield performance with respect to time of planting is similar to that of Katahdin.

The Sequoia variety was accidentally substituted for Sebago on the fourth planting date in 1942. It significantly outyielded the third planting of the other three varieties and the fourth planting of Katahdin and Irish Cobbler. This variety will be included in further date-of-planting experiments.

Scab Severity Increased with Later Planting

The yields of tubers sufficiently free from scab to be classed as marketable are shown in table 1 for 3 of the 4 regular date-of-planting experiments. Scab data were not secured from the Katahdin variety in 1940. The average yields of marketable potatoes, in per cent of total, are shown in the last section of the table for all varieties and years except Katahdin in 1940, and the Sequoia planting on the fourth date in 1942. There was significantly less scab on the crops from the earliest plantings. The average difference in marketable potatoes between the first and second planting was 72 bushels, or almost twice the average difference in total yield (38 bushels). Quite marked spreads in actual yields of marketable potatoes between the first and the later plantings of Irish Cobbler and Katahdin occurred in 1942. So much scab occurred in all plots of the 1941 experiment, that only the differences in marketable yields between the first and the last two plantings are significant. The rainfall in this year was adequate for substantial yields of both Katahdin and Irish Cobbler, but was considerably less than during the growing seasons of 1939 and 1942. This appears to be the most plausible explanation for the differences in scab. Further evidence of the influence of rainfall or soil moisture on scab development is exhibited by the relatively high yield of marketable potatoes from the fourth planting of Katahdin in 1942. A yield of 228 bushels of marketable potatoes, or 85 per cent of the total yield, was secured from this planting, as compared to 288 bushels, or 81 per cent of the total, from the first planting. A 3.61-inch rain was recorded shortly after tubers started to set on the fourth planting. The fact that the moisture content of muck soil is usually quite high early in the spring and generally becomes progressively less as the growing season advances also indicates that this is a major contributing factor in determining the extent of potato scab development in such soils.

The increase in scab with later planting in the 1939 test, summarized in table 1, was not particularly striking, although 97 per cent of the tubers from the first two plantings were classed as marketable, as compared to 84 per cent from the last planting. However, additional data

were secured from an adjacent experiment, involving a planting of Katahdin on the 18th of May and one on the 17th of June, 1939. The two plantings yielded 284 and 164 bushels per acre, respectively, of which 258 and 121 bushels, or 90 and 74 per cent of the respective totals were classed as marketable.

Further evidence of the influence of time of planting on scab were obtained from a seed treatment experiment in 1940. This consisted of five replications of each treatment planted on the 22d of May, 4 on the 6th of June, and 4 on the 23d. Data were secured from 40 five-hill plots of the first planting and 32 such plots from each of the other two. The tubers were rated separately for surface and pitted scab and a scab index calculated for each type and each planting. The results are summarized in table 2. Both types of scab were more abundant on the later

TABLE 2—*Influence of time of planting of Irish Cobbler in muck soil on development of potato scab,* 1940.

Date of Planting	Scab Indexes	
	Pitted Scab[1]	Surface Scab[2]
May 22	11	43
June 6	15	51
June 23	24	53

[1]Differences significant at 1 per cent level.
[2]Differences between first planting date and next two significant at 1 per cent level.

than on the earliest plantings. These differences were presumably due to differences in planting time, although the design of the experiment did not permit the separation of variances for soil and dates of planting.

Pitted scab was the predominant type in both of the 1939 tests, whereas the surface type predominated in the 1941 and 1942 experiments. It is not yet clear whether the particular type occurring has been dependent upon the nature of the preceding crop, kind of muck, degree of winter and early spring flooding of the soil with water, or native or introduced inoculum. The two types of scab were influenced in the same way by time of planting.

Discussion

That the early plantings of Irish Cobbler and Katahdin should give higher yields may seem rather obvious, since high mid-summer tem-

peratures and somewhat restricted soil moisture adversely affect the later plantings. The earlier plantings of Irish Cobbler outyielded the corresponding plantings of Katahdin, but the yields of the former dropped off more rapidly with delayed planting. This may be due to differences in their tolerances to summer temperatures and their responses to day-length and available soil moisture.

The increased severity of scab with delayed planting was particularly marked in the 1942 experiment. Furthermore, there was an apparent decrease in severity on the last planting. Satisfactory explanations of this behavior of scab on muck soils are being sought. Soil moisture, with its attendant influence on soil temperature, aeration, etc., probably is involved. Some control of soil moisture supply is possible in many muck fields by regulating the water table. Factors, such as early planting, that promote high yield, but which may be independent of those which influence scab infection and development may have distinct value in reducing the seriousness of potato scab in such soils. Varieties of differing maturity, tolerance to high temperatures or photoperiodic response appear worthy of study in this connection. It appears noteworthy that neither Katahdin nor Irish Cobbler take full advantage of the available frost-free growing season on the Muck Farm,—the vines of the earlier plantings maturing and dying well before frost. The latter variety, in particular, is quite susceptible to scab, but probably will produce the highest yield of marketable potatoes of any variety yet tested on the scab-infested soils of the Farm, if planted early enough to take advantage of its ability to develop tubers prior to maximum activity of the scab organism. The apparent scab resistance of late varieties, like Russet Rural on the Muck Farm, may be due to the setting and development of tubers after the peak of scab activity.

Further work is being conducted in an attempt to define more clearly the factors responsible for the variation of scab severity as related to variety and time of planting in the muck soils of northern Indiana.

Summary

Time-of-planting experiments were conducted with potatoes on the Northern Indiana Muck Soils Experimental Farm, near Walkerton, Indiana, during the period from 1939 to 1942. Both total yields and yields of marketable or essentially scab-free potatoes, were determined for crops from plantings made at 5 two-week intervals from about the 5th of May to the 5th of July.

Total yields decreased with each successively later planting, whereas

scab severity increased to a maximum during the third or fourth planting. Scab severity decreased on the last planting in 1942.

In four experiments, in which Irish Cobbler was included twice; Katahdin, 4 times; and Sebago, once, the average total yields per acre were 365, 327, 261, 170 and 76 bushels, respectively. The yields of tubers sufficiently free from pitted and surface types of scab to meet U. S. No. 1 standards were 235, 153, 96, 84 and 40 bushels, or 61, 45, 36, 42 and 40 per cent of the respective average totals for 6 of the 7 tests.

Both pitted and surface scab were influenced in the same way by time of planting.

Soil moisture appeared to be an important factor since it influenced both the yield and scab development in these experiments.

The results of these experiments indicate that the earliest possible planting of Irish Cobbler, Katahdin and Sebago is one means of avoiding losses caused by scab in the muck soils of northern Indiana.

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INJURIOUSNESS OF BORDEAUX MIXTURE[1]

James G. Horsfall and Neely Turner[2]

Connecticut Agricultural Experiment Station, New Haven, Conn.

Although "Spare the Bordeaux and spoil the potatoes" is the dictum of most potato growers and researchers in the Northeast, Bonde, Folsom and Tobey (2) in Maine have clearly shown that Bordeaux mixture reduces yields of potatoes in the absence of pests.[3] They have made a critical study of the literature which shows that this effect exists in most of the other commercial potato areas.

Nevertheless, Bordeaux mixture has received many testimonials during the life of the American Potato Journal, and doubtless all of these are justified because Bordeaux mixture has no peer as a fungicide, and in addition it either kills or repels leaf-hoppers and flea beetles. Bordeaux mixture used on potatoes probably adds more tonnage to the

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[1]This paper is a condensation of a manuscript on the subject now in preparation for publication as a bulletin of the Connecticut Agricultural Experiment Station.

[2]The writers are grateful for extensive assistance rendered by Messrs. A. E. Dimond, J. W. Heuberger and A. D. McDonnell.

[3]The term "pest" is used to cover all types of potato afflictions.

nation's basic food supply than any other single fungicide or insecticide on any other single crop.

Despite these facts, we have had a nagging suspicion that if it reduces yields in the absence of pests, it must also reduce yields when pests are present, even though the effect is over-balanced by pest control.

Since wartime needs demand maximum potato production, it seemed worth while to present a study of Bordeaux injury to potatoes made during the last three seasons in Connecticut where pests are usually severe enough to make spraying pay well. We wanted also to measure the magnitude of the dwarfing effect. It appears that Bordeaux mixture produces as much or possibly a little more injury than the 11 per cent increased production sought in the original 1943 goals.

It is the object of this paper to describe a method for unmasking the injurious effect of Bordeaux in the field so that it can be measured. The problem is to separate and measure both the beneficial effect on pest control and the deleterious effects. Injury to the plant must be reflected in lowered yield or it is unconsequential. Hence, yield must be used as a yardstick. It would be a simple problem if pest-free potatoes could be sprayed with Bordeaux to measure the injury. Although he made little of the point, Lutman (9) did spray potatoes in the greenhouse in the absence of pests and Bordeaux dwarfed them by 9 per cent. It will be seen below that Lutman's estimate comes strikingly close to the injury found in the field in Connecticut.

It is seldom possible, however, to conduct such tests in the field because either diseases or insects or both usually afflict field-grown potatoes. In order to reduce the number of pests to a minimum, Irish Cobbler potatoes were used in the primary experiments, because when this early variety is planted early in Connecticut, it matures before leafhoppers, tip burn or late blight became serious. In the three years of our research early blight did not occur. This left flea-beetles as the only pest affecting the crop. Therefore the problem was reduced to one of separating the yield reduction caused by Bordeaux from that caused by flea beetles.

The amount of the flea beetle feeding was varied by applying treatments that vary in their ability to control flea beetles. By using graphic methods the effect on yield of any given level of beetle feeding could be ascertained. Of course each treatment used has capabilities for dwarfing as well as for beetle control. Any given treatment, however, can be located on the graph according to the amount of beetle feeding that it permits. If the yield is below that indicated by the graph, it shows that the material produced a dwarfing effect.

Treatments were applied to plots randomized in each of five blocks. Each plot was one 36-inch row of eleven plants from Maine certified seed. All sprays were applied with a single gun, 200 lbs. pressure, 300 gallons per acre, with a pump capacity of six gallons a minute. Dusts were applied with a knapsack bellows duster. Ten plants were harvested for yields.

The amount of flea beetle feeding was measured by taking three leaves at random from each plant at a level approximately three-fourths of the plant height. The leaves were classified into one of five categories of puncturing, from O = no attack to 4 = dead or nearly so from flea beetle feeding. These data were converted to percentage as described by Horsfall and Heuberger (5). Before the grading system was adopted, it was compared with the method of actually counting the number of beetle feeding marks on one square centimeter samples punched from leaves at the same height. The results were identical, and the grading was adopted because of the saving of time.

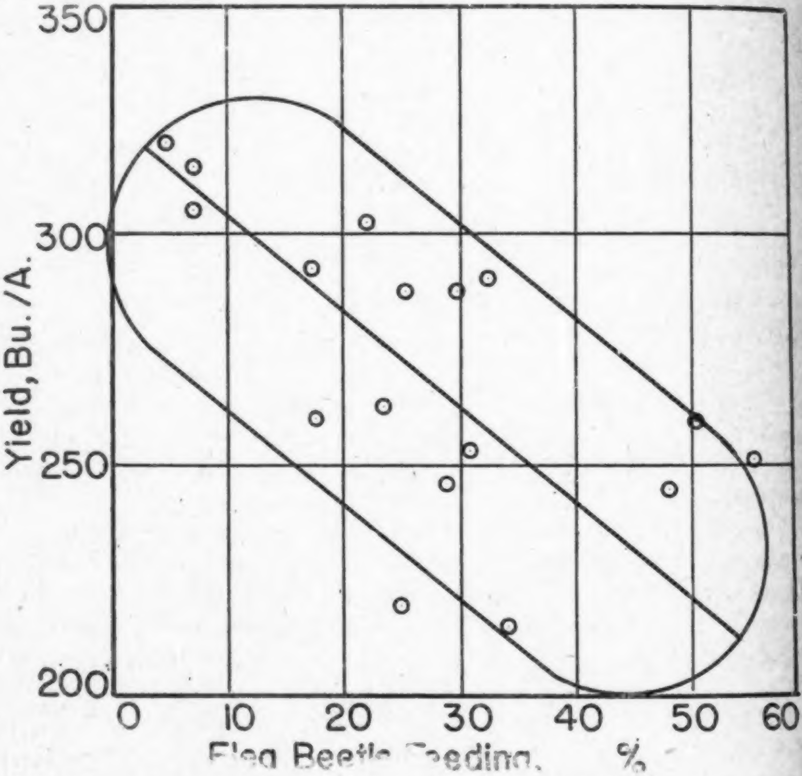

FIGURE 1.—Effect of flea beetle feeding on yield of Cobblers, 1942

Data for 1942 (Table 1) serve to illustrate the utility of the method proposed for separating pest control from dwarfing because 15 treatments and two checks were used. Flea beetle feeding varied from 4.3 per cent in the high concentration derris dust to 55.5 per cent in one of the checks. The data for flea beetle attack have been plotted arithmetically against yield in figure 1 to obtain the relationship between

TABLE 1.—*Effect of flea beetle control with various materials on yield of Cobbler potatoes—1942.*

Treatment	Concentration	Yield, Bu./A.	Per cent Flea Beetle Feeding, June 10
Check		245.5	48.5
Bordeaux	8-8-50	219	25.7
"	2.7-2.7-50	215	34.5
"	0.9-0.9-50	253	31.0
TMTD	1.5 to 50	287	29.5
"	0.5 to 50	246	28.9
"	0.17 to 50	259	50.3
Derris Pyrax	2%	320	4.30
" "	1.5%	315	6.8
" "	1.0%	306	7.2
" "	0.5%	259	17.5
" "	0.25%	264	23.0
Derris-Bancroft	2%	293	17.0
" "	1%	302	21.6
" "	0.5%	291	31.7
" "	0.25%	288	25.0
Check		251	55.5

beetle feeding and yield. Generally speaking, the yield falls as the flea beetle feeding increased.

Normally, one expects a reasonable fit to a curve when an independent variable, in this case flea beetle feeding, is plotted against a dependent variable, yield in this case. Random errors may give some variations about the curve.

In this case the points arrange themselves in a diagonal band instead of on a line. A band of points is the best that can be expected, however, because the dependent variable, yield, depends upon two mutually exclusive variables, beetle control and spray injury. The graph is plotted from the variable that can be measured; *viz.,* beetle feeding.

For equal beetle control, an injurious treatment should produce a lower yield than a non-injurious treatment. Accordingly, the most injurious treatments can be expected to fall on the graph in the lower

part of the band of points and the less injurious treatments in the upper part of the band. In fact the two untreated checks fall at the very top of the band.

A curve[4] drawn through the middle of the band of points should establish the general slope of the beetle feeding-yield relationship, because the effect of the injurious treatments below the line is counterbalanced by that of the less injurious ones above the line.

A line parallel to the generalized line can be drawn through the point for any treatment to establish the relationship between insect feeding and yield for that treatment. Assuming that feeding punctures and spray dwarfing are independent, this procedure keeps injury a constant at any level of beetle feeding.

The curve through the two checks serves to locate the relationship in the absence of injury. The magnitude of the injury from any one treatment can then be determined from the difference in yield between the treatment and the check at any given level of beetle feeding. In this particular experiment, the 25 per cent level of beetle feeding represents a fair average of the treatments. Accordingly treatments can be compared at this level without undue errors from extrapolation.

In this paper we are concerned only with Bordeaux mixture and the check. The raw data (Table 1) on yield are two checks = 248.3 bushels; 8-8-50 Bordeaux = 219; 2.7-2.7-50, = 215, and 0.9-0.9-50 = 253 bushels. The interpolated yield of the check at 25 per cent level of beetle feeding was 313 bushels per acre. For Bordeaux mixture at the same level of beetle feeding the interpolated yields would be 270 bushels (13.8 per cent decrease) for 0.9-0.9-50; 232 bushels (25.9 per cent decrease) for 2.7-2.7-50 and 219 bushels (30.3 per cent decrease) for 8-8-50.

These data have been treated by the analysis of covariance[5]. If the data on flea beetle feeding are used as original ratings (that is, before being converted to percentages), the calculated yields at the mean for flea beetle damage were, checks 278 bushels; 0.9-0.9-50 Bordeaux, 253 bushels (12 per cent decrease); 2.7-2.7-50, 221 bu. (20.5 per cent decrease); and 8-8-50, 209 bushels (24.8 per cent decrease). If the data on flea beetle feeding are expressed in probits for each plot, the calculated yields at the mean were: checks 279 bushels, 0.9-0.9-50, 257 bushels (8.4 per cent decrease); 2.7-2.7-50, 225 bushels (19.2 per cent de-

[4]The line is drawn as a straight line in the illustration, but some doubt should be registered here that such a curve is actually linear. It may be that flea beetle attack bears a logarithmic relation to yield.

[5]Analysis designed by Dr. C. I. Bliss of this Station, to whom the authors express their thanks.


TREATING SEEDS
SAVES
CROPS AND
DOLLARS
Control
SCAB and
RHIZOCTONIA
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crease); and 8-8-50, 213 bushels (23.5 per cent decrease). The differences between Bordeaux and checks are highly significant (exceeding P = .01). Regardless of the method selected (*i. e.* graphical or one of the two statistical methods) Bordeaux dwarfs potatoes.

Uncorrected yields for the 1941 Cobbler experiment were 370 and 363 bushels per acre for 4-4-50 Bordeaux and check, respectively. When the yields for 25 per cent beetle feeding were calculated graphically, the check was 398 bushels and the Bordeaux 382 bushels (4 per cent decrease). In 1940 the Bordeaux yielded 389 bushels and the check 336. Flea beetles were so abundant that the 50 per cent level of feeding was used in computations. The check at this level would have yielded 430 bushels and the treated 286 bushels (33.5 per cent decrease).

It was of interest to apply this same technique to still earlier experiments on Cobblers, completed before the present investigations were started. In 1932 and 1933 the average number of feeding marks per leaf was determined by counting. (Table 2). In both years the recorded

TABLE 2.—*Effect of flea beetle control with various materials on yield of Cobbler potatoes,* 1932 *and* 1933.

Material and Concentration	No. Feeding Marks per Leaf		Yield, Bu./A.	
	1932	1933	1932	1933
Lead arsenate 1½ - 50 + ½ pt. fish oil	60	72	140	268
Calcium arsenate 1½ - 50 + ½ pt. fish oil	69.9	88	110	224
Barium fluosilicate 1½ - 50 + ½ pt. fish oil	73.9	96	107	210
Bordeaux mixture 4-4-50	51.2	66	123	260
Check	141.8	86.5	107	228

yield of the Bordeaux plots was substantially more than the untreated. When the yield was computed, however, at the level of 80 feeding marks per leaf, the 1932 yield was 135 bushels for the check and 108 bushels (12.3 per cent decrease) for Bordeaux. In 1933 the computed yield of the check for 80 feeding marks per leaf was 255 bushels, and for the treated 235 bushels (8 per cent decrease).

Clearly, Bordeaux mixture does injure Cobbler potatoes. If the results of the seven comparisons just discussed are totalled on the basis

of equal insect attack, it will be seen that Bordeaux mixture caused a mean reduction of 13.2 per cent in yield of Cobblers.

Green Mountain Potatoes

It is generally assumed that Bordeaux mixture is more beneficial to Green Mountain potatoes than to Cobblers. It is of int rest, therefore, to apply to Green Mountains the same techniques of measuring Bordeaux injury. In this case the problem was to correct for tip-burn since late blight did not occur in our plots. The amount of tip-burn was estimated in the same manner as for flea-beetles, except that the plant was classified as a whole instead of using three leaves only. Two tests were conducted in 1942.

In one experiment two and six pounds of metallic copper per acre per application (as Bordeaux mixture) were applied in varying quantities of water in a coverage experiment. A 4-nozzle hand boom was used instead of a single gun. Every dosage of Bordeaux outyielded the checks in the raw yield data (Table 3). However, when tip burn incidence was plotted against yield (Fig. 2) the typical band of points

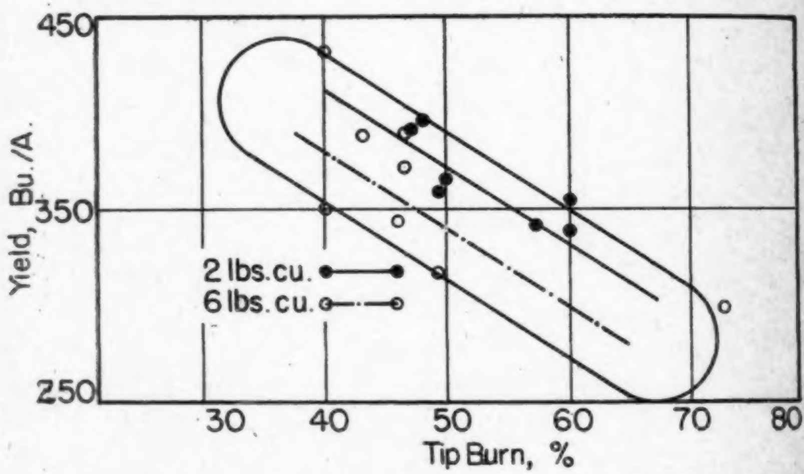

Figure 2.—Effect of tip burn attack on yield of Green Mountains, 1942

was obtained, the yield decreasing as tip-burn increased. By interpolation on the curves for treated and check, it is determined that the check would yield 390 bushels at 50 per cent tipburn, but that plants sprayed with two pounds of copper per acre per application would yield only 371 bushels (5 per cent decrease), and with six pounds of copper 340 bushels, (11.5 per cent decrease).

TABLE 3.—*Effect of tip burn control with various amounts of copper per acre and gallonage of Bordeaux mixture on yield of Green Mountain potatoes.* 1942.

Treatment No.	Metallic Copper per Acre, Lbs.	Gallons per Acre	Pressure Lbs./in.^{2}	Nozzle D. x 1/64"	Spraying Time M.P.H.	Tip Burn Per cent	Yield Bu./A.
1	2.0	100	250	3	0.75	60.0	338
2	6.0	100	250	3	0.75	49.0	316
3	2.0	200	250	3	1.50	48.5	358
4	6.0	200	250	3	1.50	46.0	344
5	2.0	400	250	3	3.00	47.0	392
6	6.0	400	250	3	3.00	45.5	373
7	2.0	280	250	4	1.50	48.3	396
8	6.0	280	250	4	1.50	43.3	388
9	2.0	374	250	5	1.50	56.8	341
10	6.0	374	250	5	1.50	47.0	391
11	2.0	130	100	3	1.50	60.0	335
12	6.0	130	100	3	1.50	40.0	432
13	2.0	317	625	3	1.50	50.0	365
14	6.0	317	625	3	1.50	39.5	350
15	Check	—	—	—	—	72.8	300

In the second experiment the check at 50 per cent tipburn, yielded 334 bushels per acre; and 4-4-50 Bordeaux, 296 bushels (12.5 per cent decrease). The mean of these three tests indicates that Bordeaux produced about 11 per cent decrease in yield of Green Mountains.

A search of the literature discloses scarcely any data capable of this type of treatment to distinguish injuriousness from beneficial effect of sprays. The fact that none was found does not refute the conclusions. Three conditions must be fulfilled, yield data, pest attack over a wide range in different plots, and an unsprayed check. Checks are often omitted because they attract flea beetles. Huckett's (7) data approximate our needs but the pest attack is only roughly estimated and the range of pest attack leaves a wide gap between the treated plots and the check. Huckett's data have been examined graphically. In some cases no relation between pest attack and yield can be found, probably because of random errors or incomplete estimates of pest damage. Nevertheless, from the data that do indicate a relation, it would seem that the dwarfing of Bordeaux on Cobblers and Green Mountains approximates 10 to 15 per cent.

Mader and Blodgett (10) reported the number of leafhoppers per leaf. They used a check, but there is a wide gap in leafhoppers between the 46 on the check and the 17.1 on the nearest treatment. As a result a line can be drawn almost anywhere on the paper. A reasonable fit to the line for the Bordeaux treatments seems to pass well below the check. Probably it is pointless to estimate just how much dwarfing was due to Bordeaux,—only that it probably occurred.

Similar computation of the data of Moore and Wheeler (12) indicates that Bordeaux dwarfed Green Mountains.

Discussion of Bordeaux Injury

There seems no escaping the fact that Bordeaux mixture reduces yield of potatoes even in areas and in years when pests are abundant. The only difference is that pest damage so often counterbalances this injury as to mask it. It is interesting to note that the comparisons available indicate that the effect on Cobblers averages about 13.0 per cent,—that on Green Mountains about 11.0 per cent. These figures come reasonably close to that of Lutman (9) who gives data to show that Bordeaux applied on pest-free potatoes in the greenhouse reduced the yield by 9 per cent.

Stated in another way, the data indicate that pests can reduce the yield of the crop from 9 to 13 per cent before treatment begins to

increase the yield above the check. If pests do not produce that much loss in yield, the sprayed plants will yield less than the check. If pests produce more damage than that amount, treatment begins to pay. This accounts for the common observation (7) that yield does not match the pest reduction.

Some Remedies

It is clear that Bordeaux injury even though often masked, is sufficiently serious to be given careful consideration especially in war time production of potatoes. Accordingly a summary is given below of information available on alleviating the injury. It should be noted that no "recommendations" are given, just facts and their implications. The usage of the facts will vary with different farmers.

This does not mean that Bordeaux should be or can be discarded as a potato spray. At this point it would be well to repeat one of the statements in the opening part of this paper—at present Bordeaux mixture has no peer as a fungicide and in addition it prevents damage to potatoes by flea beetles and leafhoppers. It is unfortunate that the mixture at the same time also reduces the yield by approximately 12 per cent.

These facts point unmistakably to the ultimate goal of finding a material or combination of materials that will control the pests and not affect the yield adversely.

In the meantime, we must depend on Bordeaux mixture for pest control and use it in such a manner as to obtain maximum effect of the pests with minimum loss of yield. In terms of practical application, potato growers in areas in which pests cause less than 12 to 15 per cent reduction in yield, cannot expect profitable yields from spraying. Growers in areas in which pests usually cause more than this amount of damage can expect increases in yield from spraying. Since the amount of Bordeaux injury seems to be related to the amount of Bordeaux used per acre, the less Bordeaux used, the better the relative yield that may be expected. This means that treatment should be made only when pest control is essential. In Connecticut, for instance, Green Mountain potatoes seldom need Bordeaux before the 1st of July to control leafhoppers or blight.

Obviously, the dwarfing effect occurs chiefly on young plants because a mature plant cannot be reduced in size. Therefore, the early applications are the most deleterious. Some potato experts contend that the plants must be covered almost from babyhood in order

to protect the inner parts from late blight. Bonde publishing in this Journal (1) showed in "a very bad late blight season" in Maine that "The sprays that gave the largest returns [yield] were those applied from the last week in July until the first week in September. It apparently was the late sprays and not the early ones that gave the best results."

Of course, farther south in the potato belt where tip burn is serious as in Connecticut, sprays must begin earlier, but even here spraying Green Mountains before the 1st of July is unnecessary.

After the 1st of July any practices that maintain pest control, but reduce the amount of Bordeaux per acre are highly desirable. In many areas droughts occur during the potato-spraying season. At such times the plants are growing very little. Diseases seldom spread much during dry weather. The residues left from former treatments should be sufficient to control leafhoppers. Therefore spraying can be delayed until rainy periods, to produce conditions favoring plant growth and the spread of disease.

Another possibility is the use of 300 gallons per acre of 2-1-50 Bordeaux instead of 100 gallons of 8-4-50 (Table 3). Use of the "weaker" strength cuts the amount of Bordeaux per acre by 20 per cent and yet provides the same control because of better coverage, and much higher yield because less Bordeaux was used per acre. The experimental evidence for this will be presented in the bulletin now being prepared. This may not be a practical method for a lot of farmers because it involves extra labor, but it remains as a possibility.

Injury from Lime

Lutman (8) sprayed potatoes with lime water in comparison with Bordeaux and concluded that the copper was the stimulatory agent. Actually, the lime water dwarfed the plants. Later it was shown that lime is deleterious to vegetables including potatoes (4). This being the case a reduction in lime should reduce injury from Bordeaux. This has been demonstrated by Blodgett *et al* (3) who ascribed the increased yield to copper stimulation as the lime was decreased. It is more likely that the lime injury was reduced as the lime was reduced.

On account of this problem of lime dwarfing much attention has been paid recently to the use of so-called "fixed copper" materials on potatoes. They seem to have had some success in Maine and Florida where insect damage controllable by Bordeaux is at a minimum, but they have not succeeded in areas where leafhoppers, flea beetles, and tip

burn are serious, because fixed coppers are inferior to Bordeaux for the control of these afflictions.

Bonde in Maine (1), Mader and Blodgett (11) in New York, and Tilford (14) in Ohio give data that can be interpreted to show that potatoes sprayed with high calcium lime under-yield those sprayed with high magnesium lime. Petty (13) in Louisiana, finds that potato yield is reduced if Wyogel bentonite, which contains magnesium oxide, is left out of Bordeaux. In Maine, the effect, in part at least, results from supplying a magnesium deficiency. Magnesium in lime dilutes the calcium and hence reduces the lime dwarfing. Magnesium is also able to antidote the deleterious effects of calcium (4) and copper, too.

From these data from Maine to Louisiana, it follows that magnesium reduces the deleteriousness of both the copper and the lime in Bordeaux mixture and hence that dolomitic lime is probably to be preferred to high calcium lime in the preparation of Bordeaux for potatoes.

Summary

Although Bordeaux mixture was known to reduce potato yields in the absence of pests, it has been demonstrated that the yields are also reduced where pests are serious. In such cases the dwarfing effect is masked by pest control.

A method is described for separating the two mutually exclusive effects when operating on the same plots. It involves determining the graphic relation of pest attack to yield, and determining by interpolation on parallel curves, the yield of treated and check at equal levels of pest attack.

The yield reduction is approximately 12 per cent on Cobblers, and 11 per cent on Green Mountains at median levels of pest attack.

It does not follow that Bordeaux should be discarded. That would be catastrophic in war time because no adequate substitutes are in sight. We must search for ways of reducing the injury. These are as follows: begin spraying as late in the season as possible; spray as seldom as possible rather than as often; use lots of water in the fewer sprays with less copper per tank full, rather than less water and more concentrated; reduce lime to half the weight of the blue stone; and use dolomitic lime.

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SECTIONAL NOTES

CALIFORNIA

The commercial potato movement from the Klamath Falls District is exceeding all previous records. The total shipments for November were 1372 cars of 450 sacks each. Our heaviest shipping day was on the 30th when 84 cars were shipped.

If the present rate of movement continues, good sand land potatoes will be hard to find in March.

The demand is very good for U. S. No. 1 grades, but No. 2's are not moving very well. People seem to have too much money and want to buy the BEST.

The demand for seed potatoes—White Rose—is very heavy in California this year. The acreage in Central California for this coming season promises to be around 50,000 acres. (Dec. 6).—E. MARX.

COLORADO

Colorado table stock shipments are still gaining on last year, and at present are about 2,300 cars ahead of the same date last year. The demand for U. S. No. 1's is excellent and prices are at the ceiling but

off-grades from U. S. Commercial down to number threes or dogs are very slow at low prices. Many growers and shippers feel that only a substantial cut in the December crop estimate and a relatively low stock in storage report in January can prevent the market from crashing during February, March and April.

Our certified seed demand is very great and a major part of the larger crop this year has been booked at ceiling prices. In the case of war approved seed, the demand has been slower, but is picking up as growers learn what this new class is, and also since the available supply of certified seed is becoming exhausted.

The weather has been unusually mild, with little moisture. As a result, some growers have not been able to cool their cellars as much as they would like.

The labor situation during potato harvest was better than last year. The usual labor was supplemented with High School students, Mexican Nationals, Japanese, German prisoners of war and Indians. Although this labor was not so efficient, except in the case of some of the Japanese and all the Indians, as the labor we have had in the past, it was only necessary to increase the number of pickers per field as nearly all of them were paid by the sack. A little trouble was experienced at first with some of the Germans, but after some with sabotage in their systems had been removed, they proved to be ⅓ to ½ as efficient as experienced potato pickers. (Dec. 10).—C. H. Metzger.

IDAHO

Our shipments of Idaho potatoes have held up well into the early part of December with prices at or close to ceiling. On the 4th of December, total shipments for the year exceeded last year by nearly 3,000 cars. Approximately 1,000 of these cars were from the late areas. With the losses from freezing, the amount to be dehydrated, and those held for local use for feed, food and seed, the total of 16,087 cars shipped as of this date should approach the halfway figure in shipments from Idaho for this year.

Dealers and handlers, who were contacted on the Chicago market last week were pessimistic over the market and regular flow of potatoes because of the recent demurrage regulations. They indicated that under these regulations it was impossible to divert some cars from Chicago to other receiving points and that Chicago buyers were seeking these distressed cars at buyers' prices.

Certified seed in Idaho is pretty well contracted for, and it appears

that late buyers may not be able to fill their orders. During the spring months, the seed will move at ceiling prices. Idaho seed growers are fairly well satisfied with the ceiling set. Most of the dealings prior to the announcement were close to the ceilings established, although some growers based their calculations on $1.50 spread above commercial ceilings. (Dec. 7).—EUGENE W. WHITMAN.

LOUISIANA

Our seed has been ordered out for the month of December and January. At present, the indications are that we will have some increase, although it is too early to tell exactly how much. We have just had a meeting of the Louisiana Irish potato growers at which the following officers were elected for the coming year: L. A. Boone, Raceland, President; Robert Morrison, Cut Off, Vice President; also P. T. Ecton, Baton Rouge, Sec.-Treas. These new officers are taking an active interest in the matter of ceiling prices, support prices and transportation. (Dec. 6).—P. T. ECTON.

MICHIGAN

Our movement of table stock was heavy all fall, but by late November all of the stock in temporary storage had been moved out and the shipments fell off. All indications are that shipments will be light until early January.

The demand for certified seed has been very good. Only a few sales have been made with definite price; however, a large quantity of the crop is already reserved. (Dec. 15).—H. A. REILEY.

MISSISSIPPI

The only thing I can give you at the present time is the production goal for 1944, which is 36,000 acres or 3 per cent higher than last year's planted acreage. This is the total for both market and farm use. The 1942 commercial acreage was 3,000. Indications point to some increase in commercial acreage next year as a result of fair prices obtained for the 1942 crop. The increase, however, may not exceed the 1944 increased acreage asked for by the War Board.

Factors tending to limit acreage will be the critical labor shortage and higher prices of seed potatoes compared with 1942. Planting usually begins in the southern end of the state during the latter half of February and runs through the 15th of March in the central part of the state. Most

of the commercial production is in southern and central Mississippi. (Dec. 9).—J. V. PACE.

NEBRASKA

The final bin inspection on Certified and War Approved seed potatoes has been completed. In view of the increased acreage of Certified and the additional acreage entered for War Approval, this inspection program has been slower than usual. The results of this final inspection show that yields are materially lower on all potatoes than a year ago. As shown in a previous report from Nebraska, the yields in dry land territories were the lowest experienced since the drought years of 1936 and 1937. Many growers received slightly more than their seed planted. Our acreage yields in those areas of approximately 100 bushels were cut in two, and of course, the tuber size being exceptionally small, the stock is not so marketable as usual.

The conditions in the irrigated areas were more favorable, though the early frost which affected the dry land areas most severely, also cut the yields under irrigation. An average of 200 bushels per acre is usually expected and this is probably reduced by 50 bushels per acre for the season. An occasional grower harvested 350 to 400 bushels per acre, whereas most of the certified growers expect such a yield in average seasons.

The quality of the crop, from a disease standpoint is good. The usual troubles, such as flea beetle injury, etc., are somewhat reduced. However, flea beetle injury was found in new areas during the year. Stem end discoloration, a difficulty common in Nebraska, is causing very little trouble this season. In addition to scab, which plagues the grower at the time of grading and marketing this crop, will be a high percentage of tubers with mechanical injury. Many growers were faced with the necessity of using additional mechanical equipment, during harvest, which accounts for this difficulty, though extremely hard soil, due to drought conditions, contributed its share to the damage.

The sales of certified potatoes have been excellent and ceiling prices have been received since the marketing season began. Practically all of the crop is marketed at this writing. The only portion left will be that which the growers are holding back, awaiting their final grading, in order to avoid over-selling.

Demands for seed for planting in 1944 are good. It appears that an increase in acreage in seed and table stock areas can be expected. (Dec. 12).—MARX KOEHNKE.

NEW YORK

There is a rather strong feeling among leading potato growers that the New York acreage in 1944 will be reduced. This feeling is based on two principal factors. In the first place, many growers who increased their acreage in 1943, were not able to get it sprayed satisfactorily. The result was loss from blight rot and a reduced yield. In the second place, these same growers had difficulty in finding labor to harvest, and storage to store the crop. They also lacked the necessary specialized machinery. A third factor which is likely to reduce the acreage next year is the feeling that there will be a sluggish market for the record crop which will still be unmarketed next spring. Even though the movement to market up to now has been more rapid than normal, this does not account for enough of the expected surplus which is likely to suffer for want of a market and sufficient cars to move it next spring. Already potatoes are selling below the support price level on Long Island. Facing a critical labor shortage next year, growers are not optimistic about 1944, especially if they have difficulty moving the balance of the 1943 crop.

The annual meeting of the New York Cooperative Seed Potato Association was held at Syracuse on the 10th of December. All directors whose terms expired were reelected to succeed themselves. A. G. Allen of Waterville is president, H. J. Evans of Georgetown, secretary and manager. There seemed to be general agreement at the meeting that the supply of certified seed is moving more rapidly than normal and that there is likely to be an actual shortage of good certified seed available by next spring.

The annual convention of the Empire State Potato Club will be held at Hotel Utica, Utica, New York, on the 5th and 6th of January. The usual trade show, potato show, 4-H show and contests, and college educational exhibits will be featured. Subject matter of most prominence will include sessions on green manure crops for the potato grower, custom spray rings, the ring-rot disease, and marketing. All growers from New York and neighboring states are invited to attend. (Dec. 15).—E. V. Hardenburg.

OREGON

Our potato harvesting was completed during the first week in November. The use of Mexican Nationals and troops was of tremendous value as our labor supply was very short. Our yields were about average—the acreage being the largest in history. All shipments

were particularly heavy—over 1,700 cars being shipped in November. A dehydration plant is under construction, and will be ready for operation between the 15th and 20th of December.

All certified seed is of excellent quality this year. Bin inspections are now being made, and some shipment of White Rose to California is underway. We estimate that 100 cars of this variety will be shipped out during the next 40 to 50 days. Interest in seed is excellent and considerable improvement in planting stock should be made in 1944.

The tentative plan of our growers is to increase the acreage of certified seed. (Dec. 6).—C. A. HENDERSON.

PENNSYLVANIA

During 1943 there were 2,115 acres of potatoes entered for seed certification, compared with 1,505 acres in 1942. In 1942 there were 884 acres certified, compared with 1,182 acres this year. The total number of bushels certified for planting in the 1944 crop is 307,834 bushels, compared with 211,330 bushels certified in 1942. The acreage entered and certified and the number of bushels certified is the largest on record since the work was started in 1921.

The varieties certified, arranged in their order of importance, are: Russet Rural, Katahdin, White Rural, Sebago, Chippewa, Houma, Sequoia, Cobbler and Mesaba.

Of the total acreage entered for inspection this year, 44.1 per cent were rejected. Rejections were made for leafroll, mosaic, ring-rot, lack of isolation and other minor causes.

The crop is uniform in shape, comparatively free from disease, including scab and surface blemishes. The average per acre yield was 260.1 bushels, compared with 238.8 bushels produced in 1942.

Pennsylvania ranked 13th in the production of certified seed potatoes in 1942 among the 25 states that produced certified seed potatoes last year. This state ranked first in the production of White Rurals; second in Russets; fourth in Katahdins, and ninth in Chippewas. (Dec. 15).—K. W. LAUER.

VIRGINIA

Tidewater, Virginia potato growers have recently finished harvesting their fall crop. The principal variety grown is the Sebago but Sequoias have been tried experimentally on a large number of farms this year. The Sequoia has given the highest yield on the less fertile soils, but, on

the average or above average soil, the yields for the two varieties have been similar. The chief objection to the Sequoia is that under favorable conditions, it produces very large tubers, which are likely to be hollow. The tubers are also susceptible to late blight and the cooking quality is inferior to that of the Sebago. Yields have been excellent where the growers were able to obtain a good stand, but in most cases, the stand has been rather poor due to the rotting of the seed pieces a few days after planting. The best practice in eastern Virginia for the fall crop, which is planted during the latter part of July to the 10th of June, is to plant whole potatoes of 1¾ inch diameter or smaller, to prevent loss by rot. This, however, applies only to the newer varieties such as Sebago and Sequoia which apparently do not suberize very well. In future years there may be some demand in the northern seed-producing areas for small certified seed potatoes for planting in eastern Virginia.

The spring acreage of Irish potatoes for Tidewater Virginia will depend, to some extent, on the amount and type of credit available and the ceiling and support prices which will be enforced during the marketing season. The War Food Adminstration has requested that the acreage allotment for Virginia be decreased 3,000 acres under that of 1943. (Dec. 13).—H. H. ZIMMERLEY.

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